SCIENCE LIBRARY

DEC 19 1922

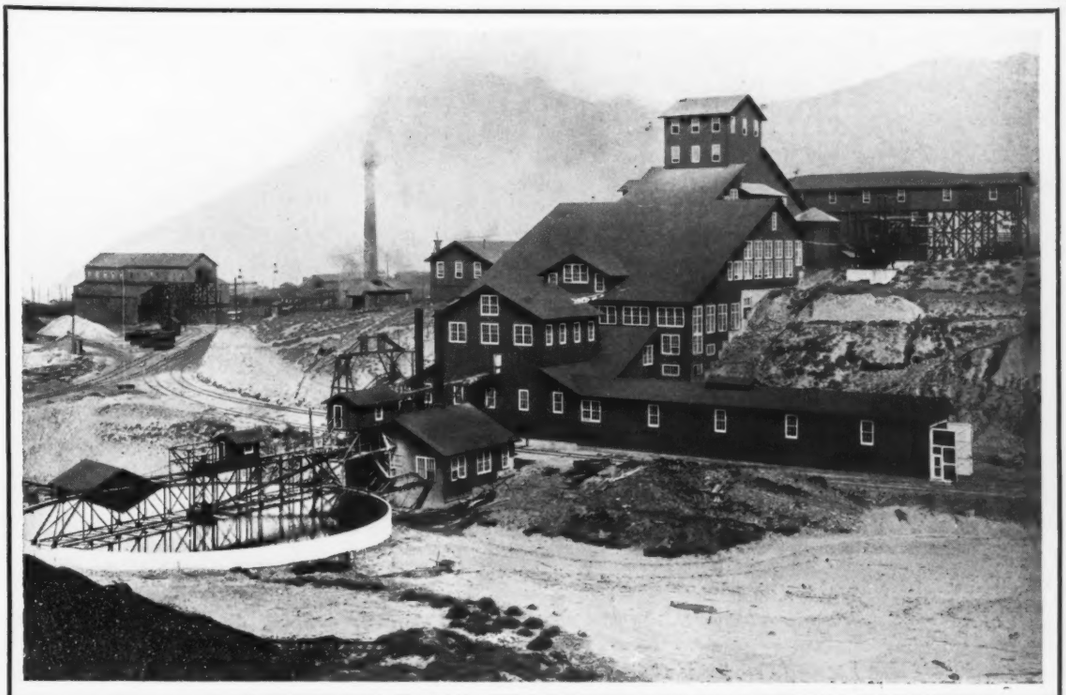
ENGINEERING & MINING JOURNAL-PRESS

A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

McGRAW-HILL CO. INC.

PRICE 15 CENTS

New 1,000-ton concentrator
of Utah Consolidated Mining Co. at Tooele, Utah.
International Smelter in background



Magnetometric Determinations
Applied to Placer Mining
By Arthur Gibson

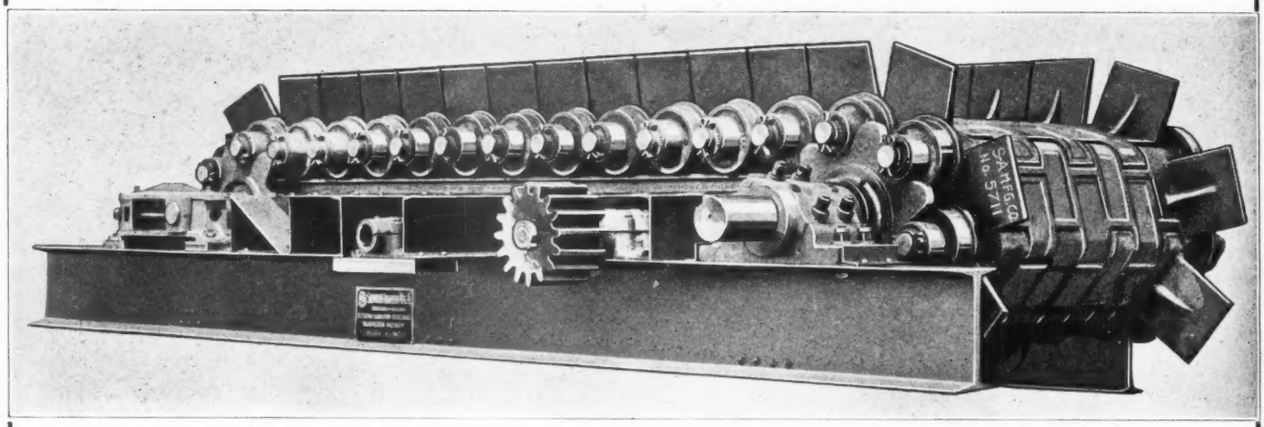
Dust in Milling Plants
By M. W. von Bernewitz

Investigation of Losses
in Copper Blast-Furnace Slag—II
By D. F. Stedman

A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

December 16, 1922

GIANT TYPE CAST STEEL FEEDER



For Handling Steam-Shoveled Material

Where the big, heavy chunks of ore crash down with a dull thud, spelling destruction for any feeder other than the sturdy cast steel type.

This is a highly successful feeder for handling steam-shoveled product. The size and strength of the parts permit of dumping carloads of heavy lump ore directly onto the feeder with no chance of damage.

This feeder is built of heavy 12-inch pitch cast steel sections made up in two widths—48 inches and 60 inches respectively. The staggered projections are bored to suit a heavy steel shaft which couples two adjacent sections. Heavy webs are cast on the sections to form sides to increase the carrying capacity and to prevent spillage. On each connecting shaft two cast flanged rollers, 10 inches diameter, are mounted for carrying the feeder on 60-pound rails. Additional rollers are mounted, outside the track wheels, for engagement with the driving sprockets. The feeder sections are carried by two auxiliary T-rail supports under the loading point.

Catalog No. 26-F illustrates and describes various classes of feeder equipment.

Write for Catalog 26-F.

Write for details and prices

AURORA SA MFG CO ILLINOIS

STEPHENS-ADAMSON MFG. CO.

AURORA, ILLINOIS

T. A. RICKARD
Contributing Editor

G. J. YOUNG, Western Editor
A. H. HUBBELL, Managing Editor
H. H. ROBIE, Metallurgical Editor
D. R. A. CHARLTON, Business Editor

ENGINEERING & MINING JOURNAL-PRESS

J. E. SPURR, Editor

F. E. WORMSER
W. N. P. REED
A. W. ALLEN
A. B. PARSONS
Assistant Editor.
BENJAMIN L. MILLER
ROBERT M. HAIG
Special Consulting Editors

Volume 114 New York, December 16, 1922 *Number* 25

Cheap Oxygen and Its Metallurgical Application

ANNOUNCEMENT was recently made that the U. S. Bureau of Mines is to investigate the possibility of the manufacture of oxygen at a low price and on a large scale, and will also make a study of the benefits to be derived from the use of oxygen and oxygen-enriched air in metallurgy. The suggestion that the Bureau carry on research on this subject was made, we understand, by Dr. Cottrell, and a capable staff has been assigned to the work. We mentioned Dr. Cottrell's connection with this subject in an editorial published Sept. 4, 1920, wherein we suggested the desirability of the further experimentation which has now been authorized.

The advantages that might accrue from a furnace air blast containing more oxygen than is present in air have often been thought of by metallurgists troubled by slow-running charges and furnace accretions. The possible benefits extend to both ferrous and non-ferrous furnace practice, and, further, beyond the realm of pyro-metallurgy to hydrometallurgical work where ordinary air is sometimes found to be not quite so strong an oxidizing agent as is desirable. An oxygen-enriched blast would seem to be particularly applicable to the pyritic smelting of copper ores, either as an emergency measure or as regular practice. In converter work, an increase in the percentage of oxygen in the blast would permit the converting of high-grade mattes and cold material to a greater extent than is now possible. A small amount of oxygen might extend greatly the field of application of pulverized coal as a blast-furnace fuel. There are also possibilities of the use of cheap oxygen in the cyanide process.

So far as we know, no practical tests of any magnitude, in which oxygen or oxygen-enriched air has been used, have ever been carried out on metallurgical furnaces. The only common uses of oxygen about a smelter are for the thawing out of frozen tap holes (the oxygen then being blown through a small iron pipe whose point is previously heated to redness), and in the oxy-acetylene blowpipe for cutting metals that formerly had to be sawed. For both of these uses pure oxygen confined in steel tanks is used. This form of oxygen is too expensive, and the amount available is too limited, to make experiments in the larger field advisable. So the first problem of the Bureau of Mines is to devise a method of making oxygen in large quantities at a small price. The purity is not important. Ordinary air contains 23 per cent of oxygen by weight; if this could be raised even to 30 per cent by some simple means, its increased activity as an oxidation agent would be marked. The densities of nitrogen and oxygen are not far different, 0.9701 and 1.1052 respectively, so that a separation based on this property would be difficult, and yet a delicate centrifugal separator might be designed. At present, of course, the major production of oxygen is by a thermal process based on the fact that liquid oxygen boils at 183 deg. C. below zero, compared with nitrogen at 195.

The subject of the Bureau's proposed research work is important and the problem is of just the type that the Bureau should tackle. The cost of doing the work, properly compared with the possibility of success and the probable metallurgical economies that would be secured, does not make the subject an attractive one for the research department of an individual or company.

Another such subject that we would like to see the Bureau take up is that of the utilization of the heat in slags that are now poured on the dump in a molten condition. This enormous waste of heat, while, at the same time, coal and coke are being burned in the furnace producing the slag, is a constant source of mortification to the thoughtful metallurgist.

Pebbles for Tube Mills

THE ARGUMENT that it is better to import cheaply than manufacture dearly has obvious logic, but, unfortunately, it is used too often to obfuscate the issue when the utilization of a local product is under consideration. For example, it has been maintained in some quarters that foreign flint pebbles are essential for the economical and efficient operation of tube mills. To satisfy those who persisted in this opinion, European stone was transported for long distances and at almost prohibitive cost. It did the work required; many engineers believed that it was irreplaceable, a conclusion reached largely because no trouble was taken to estimate quality on a numerical basis, so that comparison could be made with local stone.

Nature must have been unusually unkind to the operator who is justified in the continued use of imported Danish pebbles. We quote an instance to show the advisability of making an investigation before accepting the expense as inevitable: In a circular recently issued to the stockholders of the Hedley Gold Mining Co., of British Columbia, it was stated that local pebbles had been substituted for Danish flints, and with satisfactory results. Mr. G. P. Jones, the general superintendent, adds that the tube mills require "less than five tons per day at $4 per ton, or $600 per month, whereas with Danish pebbles our cost for August was $2,800 and the average per month is about $2,600." The company has cancelled outstanding orders for imported flints, which were costing $33 per ton. The pebbles now being used are collected locally; when the supply is exhausted it is probable that a stone can be found near by that will prove hard enough and tough enough for use in the tube mills. A few more economies of this nature might put the Hedley company back into the dividend-paying class.

It seems a pity that no concerted action has been taken to standardize such mill supplies; for had this been done it would have shown that money was being wasted on material that was imported merely because it was of foreign origin.

Yet Another Copper Process

MORE IN SORROW than in anger do we draw attention to yet another copper-extraction process, emanating from Los Angeles, in the hope that enlightened publicity will serve to restrain the enthusiasm of the gullible and divert the efforts of the inventor into other channels.

The Tracy process, heralded by the usual newspaper publicity, treats "All kinds of copper ore. . . . Low-grade ore showing only 1½ to 2 per cent can be handled with a profit . . . Gold, silver, and other minerals which may be in the ore are recovered from the tailings after the copper is extracted. . . . Copper can be produced under present conditions at a cost around 7c. per pound. This includes mining, milling, labor and materials."

According to an official statement, the ore is first ground to 20 mesh. "It is then placed in a wooden tank and submerged in a weak chemical solution. Compressed air keeps the solution agitated. Leaching thus proceeds rapidly; usually only ten to fifteen minutes is required, depending on the nature of the ore. The leached mixture is drawn into a double-bottom filter. The copper solution is forced by vacuum-pump pressure into a vat, under the filter, and from thence pumped into a precipitation vat. Here, again, air agitation is used. The copper is precipitated upon plates without throwing down any ferric salts in it. Precipitation usually requires from four to eight minutes. The copper is next delivered into a receiving tank in the form of cement, absolutely free from any metallic crystals, grit or iron. The leaching solution is drawn from the leaching tank and transferred to the first vat or leaching tank. It can be used over and over again with slight loss of strength. The copper cement product dries quickly to a very fine powder or is pressed into briquets."

The justification for newspaper publicity is contained in the report by a firm of Los Angeles assayers and metallurgists, dated Aug. 31, 1921, describing a test made a few days previously. After enumerating the various steps in the process, the report adds that, "The copper content of the ore was unknown at the time the test was made; and as the amount of acid required could only be approximated, no attempt was made to check up on the amount of acid used."

Verbum sap. Samples taken for assay show that 94.4 per cent of the copper in a 15 per cent ore was extracted during treatment, leaving a residue containing 0.83 per cent. "After leaching out the copper," the report continues, "the tailings were concentrated on a Card table to recover the gold." The results show a final loss of 1.02 oz. gold and 21.08 oz. silver per ton in the table tailing, the report adding that, "An ore with such a high gold and silver value would justify a cyanide treatment, but after concentration or amalgamation, which would be necessary to recover a certain amount of coarse gold present."

The available data indicate no points of superiority in the Tracy process over well-known and practicable methods in present-day operation. The claims of the inventor are illogical. The profitable treatment of low-grade ore (1.5 to 2 per cent) by this process, after crushing to 20 mesh, is highly improbable. A production cost of 7c. per pound of copper appears to be out of the question. Mechanical complications, consequent on the adoption of fine crushing, agitation, and pulp thickening, and vacuum filtration of a 20-mesh material, would be inevitable. Capital cost and upkeep expense would be high; and, finally, the product, cement copper, is not pure and would not command a high price.

The inventor claims that "If heat is applied it becomes solid metal, very compact and ductile"; the newspaper account states that the process "will permit the manufacture of an improved copper paint, reduce the resistance for the transmission of electricity in copper wiring and make possible the production of a malleable copper." But we remain unmoved; Mr. Tracy must make good his claims with convincing evidence before any further attention can be paid to his process, either by metallurgists or operators.

The World at Large

OUR SUBSCRIBERS in general approve of an occasional editorial dealing with current world conditions. We run the *Journal-Press* for our subscribers, soured readers who assume the contrary notwithstanding. We will not undertake to correct the popular illusion that all editorial pages are dictated by advertisers. Like all popular legends, such as the Unspeakableness of the Turk, and the belief that the Basin ranges are due to block faulting, it must run its course. As a rule, men judge by what they would do themselves. "The trusts," said an impassioned citizen, "are extracting millions from the people." Then, as he contemplated the picture, he burst out involuntarily, "I wish to God I owned one!"

Other readers, however, elevate us too highly. One such wrote in and asked that we should use our opportunity and influence to preach a new economic gospel, which should lead to a new social order; and that we should abandon the traveled and crowded roads of popular economic thought.

We sympathize with this reader. The world is all wrong, without any exaggeration. The century past has seen marvelous strides in mechanical progress, but little progress in spiritual things, which, after all, differentiate men from beasts and stones, and through which alone the world can really advance. Many inspired seers of the material world have arisen, and we have a new mechanistic life and social organization: but no new spiritual leaders. The ancient and revered spiritual leaders have frankly not transformed the world: their followers are sunk by groups in bigotry and spiritual atrophy. Economic leaders arise by the hundred. Commercialism, thrift, work, efficiency, the chase of the will-o'-the-wisp dollar, constitute our chief virtues and bring into relief our fatal deficiencies. Materialism, which has revolutionized the world and made it wonderful to see, bids fair to wreck it. We need a new prophet more than we need cheap fertilizer. But we cannot qualify.

We can, however, call attention now and then to those who are speaking the truth amid the universal clamor. Such, for example, as the speech of General Pershing recently, before the Association of Commerce in Chicago. General Pershing pointed out the existing danger to civilization. Specifically, in this country, he condemns the Ku Klux Klan, the Herrin massacre, the Communist Party of America. "It is inconceivable," said he, "that we should become so engrossed in our own individual affairs, or the pursuit of wealth, that we should continue to neglect our plain duty to establish law and order."

However, this is not only conceivable but true. What we all need is not more business but more religion.

We have scant religion in the world, although there exists a crushing superabundance of religiosity, which is stupid, fetters mind, substitutes forms for ideals, dogmas for noble actions: it is a crime against progress, breeds Ku-Kluxism, hatred, fraternal wars, as in Ireland; curses the world and keeps it wicked. Religiosity is a monstrosity.

As for religion, we know in our hearts what that is, and need not have it defined. We need it, or progress and evolution will fail, and that with or without legislative condemnation.

The Degradation of Engineering

WE HAVE RECEIVED certain mimeographed sheets from the American Association of Engineers upon which is printed as a general title "News of Engineering Progress." The subject of this communication is, "Reciprocity in the Practice of Professional Engineering." In it are described the proceedings of the Council of State Boards of Engineering Examiners, which is now struggling with the intricate problem of state boundaries in relation to licensing engineers.

Pandora's curiosity in opening the box that Zeus gave her released, we are told, all human ills. Hope, also in the box, was all she prevented from escaping. Humanity is gradually finding by experience what these ills were. Licensing of engineers was also in the box, but this particular ill might have roamed around for a considerable time had it not been for the unwisdom of struggling mankind. Innocent enough, perhaps, was the proposal for issuing a state license to engineers. Forthwith arose the necessity for defining what constitutes an engineer. Next in sequence was the problem of sorting the various degrees and kinds and the determination of the criteria by which the so-called engineers were to be given the licenses. Travail of more or less acute dimensions resulted in the formation of various state boards and a machinery for the determination of qualifications and the issuance of licenses on the receipt of the inevitable fee.

Apparently all was well. The trusting public recovered from the shock, but the engineers who derived their practice broadcast from more than one state, and some who relied upon the world at large, at last awoke to the fact that they would have to take out several licenses and some of them many licenses. They were indignant at the stenographic expense, the time, and the cumulative fees that would be required. In time their protests become apparent. The imps who had caused the trouble rushed to the rescue. Patient humanity now has reciprocity in the practice of professional engineering. It also has to support a Council of State Boards of Engineering Examiners. Both engineers and the public support this. In the future we will, no doubt, have an international council for carrying onward the reciprocity idea.

Of the articles of agreement for reciprocity between states, Article 1 states that reciprocal registrations shall be granted only to an applicant who is already licensed in some state which is a member of the Council. "A detailed professional record, properly attested, and accompanied by references as to character and qualification from three registered practicing engineers shall be filed with the applicant's board of engineers. Qualification for reciprocal registration shall be determined upon the basis of such professional record, thorough consideration of which shall constitute examination."

Article 3 gives one an inkling of where engineering begins and where what goes before engineering stops. An "actual transitman" begins to score in engineering experience; anything in advance of apprenticeship, foremanship, inspectorship, or other subordinate position in shop or laboratory gets on the score card; after inking and getting into design, the draftsman can begin to notch up his stick; only a full-time instructor in an engineering school of recognized standing can put beans in the bottle, one for each year of full-time instruction.

Article 4 states that an applicant must have ten years of experience in professional engineering, and, in addition, he must be able to design as well as to direct engineering operations. The Council states naïvely that "each case shall be considered on its merits, and the experience record must be given in such complete detail that the Board of Examiners can determine the character of work performed by the applicant."

Graduation from an engineering school of recognized standing enables the luckless graduate to put four beans in the pot of engineering experience. Any school can qualify as "an engineering school of recognized standing" if it requires a high-school diploma for entrance and gives the equivalent of a four years' course in engineering for graduation.

The candidate for reciprocity, if he satisfies his own board of examiners, receives from them a certificate which, if accompanied by the legal fee (the money to grease the machinery of reciprocity was not overlooked) carries recognition in any state that has cast its lot with the Council. A reciprocal certificate can be revoked on evidence of incompetence or where the recipient's character has suffered a relapse. In case of dispute, the subject under disagreement is referred to the Council at its next regular meeting. If the candidate is in danger of starving in the meantime, the Council resorts to letter ballot, although the Council gives itself a limit of sixty days to count the votes upon the question in dispute.

We commiserate the engineer upon the outlook. Fortunately for our mining engineers, only a few mining states have succumbed to the delirium.

Cleanliness, Order, and Efficiency

CLEANLINESS, we are told, is next to godliness. In some metallurgical plants, we would add, it is next to impossible. Much of this is due to faulty design and arrangement of units, to an unnecessarily close grouping of apparatus, to an inability to anticipate the normal sequence of cause and effect. Our sympathies go out to many superintendents of our acquaintance whose existence is one long struggle against unsatisfactory conditions—conditions over which they have no control. A badly designed metallurgical plant—one in which cleanliness and order are conspicuous by their absence—is a perpetual source of worry and disappointment; it is more than that, for it breeds an attitude of despair among those responsible for results, a despair that is usually the forerunner of indifference. No technician or operator can be expected to maintain a healthy enthusiasm over his work when conditions exist for which there is no obvious remedy apparent short of heavenly intervention.

There are many plants in operation, however, in which no just cause exists for the dirt, confusion, and disorder that hits the visiting engineer in the eye, as it were. Cleanliness and system are evidences of effi-

ciency, and superintendents will do well to put these characteristics at the head of the list of desirable qualifications. We have visited plants in which it was obvious that unusual care and attention had been given to the stationary equipment and moving machinery, where the floors were spotless and where unsightly collections of rubbish did not exist. It has invariably happened that at such places the metallurgical results were available in considerable detail and given publicity with commendable frankness. This indicates a close connection between cleanliness and efficiency, although we are willing to admit that the good work being done connoted a strict as well as an interested control of operations, and that this, in turn, was responsible in large measure for the excellent results. On the other hand, a dirty and slovenly plant is usually the home of statistical secretiveness. It is here that the smoke screen of alleged inventiveness and technical progress is used to camouflage results and explain the absence of frankness.

To some operators, cleanliness and order are evidences of the entry of faddism into industrial work. But metallurgy depends so much on the successful application of scientific principles and precise research that no logical reason can be adduced to explain a disregard of the foundations of technical success—the elimination of the unnecessary and the systematization of the essential. In short, cleanliness and order should be insisted upon until a habit is formed, after which it will be found that the road that leads to efficient operation is the easiest one to follow.

THE JOURNAL-PRESS STAFF

BENJAMIN LEROY MILLER

BORN on a Kansas farm on April 13, 1874, Benjamin Leroy Miller's first contact with matters geological was through stubbing his toes on Carboniferous limestones when, as a barefoot boy, it fell to his lot to drive the cows home from the pasture. These stones were also used to frighten robins, blackbirds, and jays from the cherry trees. They were rich in fossils, and, in company with his maternal grandmother, who was keenly interested in geology, many happy days were spent in collecting specimens. In later years he was much disappointed to discover that his fossil "turtle" was only a piece of sun-cracked limestone and that the stone "butterflies" were *Chonetes granulifer.*

Professor Miller obtained his early education in the public schools and in the preparatory department of Washburn College, from which institution he entered the University of Kansas, where he had the good fortune to come under the influence of Prof. Samuel W. Williston and Dr. E. Haworth, both enthusiasts in their chosen lines of geology. During the summer of 1896 Dr. Haworth offered him the opportunity to do field work in western Kansas in search of underground waters for irrigation purposes, and that experience fixed his determination to specialize in geology. For three years after graduation from the University of Kansas, he taught biology, chemistry, geology, and physics in Penn College and in the vacation periods traveled through the Rocky Mountains with students and studied the geological phenomena of Yellowstone Park with a party from the University of Chicago, or worked on the Iowa Geological Survey.

From 1900 to 1903 Professor Miller pursued graduate work at Johns Hopkins University, receiving the degree of Ph.D. in February, 1903. In the fall of that year he went to Bryn Mawr College as associate in geology and remained there until called to Lehigh University as professor of geology, in 1907. He has done professional work for the U. S. Geological Survey and the State Geological Surveys of Kansas, Iowa, Maryland, Virginia, North Carolina, and Pennsylvania, and has made frequent examinations and reports for mining companies

BENJAMIN LEROY MILLER

and individuals in the United States and Latin America. In consulting work his experience has been similar to that of most consulting geologists, whose chief function it is to discourage the useless expenditure of money on "forlorn hopes." He is specially interested in economic geology, and has specialized in the study of graphite, mineral paints, limestones, iron ore, and coal. In 1915 he visited most of the important mining districts of South America and Cuba, and, in collaboration with J. T. Singewald, Jr., published a volume on "Mineral Deposits of South America." He has achieved marked professional distinction by his frequent lectures upon the results of geological and geographical research.

During the last summer, in company with a party of representatives from numerous colleges and universities organized by the European Student Relief Bureau, Professor Miller spent some months on the Continent in the study of economic and political conditions in nine of the European countries, with especial attention to what were recently known as the Central Powers.

Professor Miller married Mary A. Meredith in 1904. He is a member of the Tau Beta Pi, Sigma Xi and many geological and mining organizations. He has been Consulting Editor for *Engineering and Mining Journal* and *Engineering and Mining Journal-Press* since February, 1920. Since 1907 he has made his home in Bethlehem.

Golf and the Engineer

BY T. A. RICKARD

IN A RECENT ISSUE of our esteemed contemporary, the 'Journal of Electricity and Western Industry', we find reference to a letter addressed by Mr. Elbert H. Gary, chairman of the United States Steel Corporation, to his branch managers. In that letter Judge Gary suggests to these gentlemen the propriety of sparing a few minutes each day from their golf for the purpose of assisting him in making a little money for the corporation. Whereupon our contemporary remarks: "What is a mere contract compared to a perfectly executed mashie approach". That is a question worthy of deliberate debate. When all is said and done a mere contract may be broken, whereas a perfect mashie shot is a joy forever! Moreover, we have good reason for believing that our contemporary speaks feelingly, for he—to personalize—is said to make eminently satisfactory contracts more frequently than he makes perfectly executed mashie approaches, therefore it is natural that he should appraise them in accord with the inexorable law of supply and demand. In more serious vein, he observes: "Really, isn't this golfing idea just a little bit overdone?" We think it is. Let us confess it manfully and look Judge Gary—and the rest of the world—unblinkingly in the face. One can have too much of a good thing, whether it be milk or whiskey. A proverb says, "All work and no play makes Jack a dull boy", but the proverb, like others, has its corollary, which is equally true: "All play and no work makes Jack a poor boy". In this matter, as in most of the affairs of life, a happy medium and a sane compromise is desirable. We have known young men that were so devoted to their golf—and their dominoes after luncheon—that they allowed the procession of life to pass while they were playing skittles in an alley, as it were. We have known others that kept their noses so closely to the grindstone that they missed the perfume of the rose. In truth, we had supposed that intensity of aim as expressed by close application to business was a mark of the young American. In other lands, of course, there were—we understood—young men showing similar singleness of purpose, but the concentration of effort we accepted as the characteristic of our own countrymen. On the other hand, we had accepted the young Englishman as the type of those who are devoted to outdoor sports, to the neglect sometimes of more serious affairs; moreover, in his sports, we believed the Englishman showed a keen appreciation of the spirit of the game, whereas the young American, it seemed, brought a businesslike intensity even to his pastimes, and so robbed them of some of their joyousness. We have noted, for example, when visiting a large mine, that when the day's duties are done the young Englishmen on the staff drop readily into talk on golf or polo while the young American technicians discuss the origin of an ore deposit or the development of the flotation process. It is said that at forty a man is either his own doctor and philosopher or a fool; indeed, if he be observant he may become something of a philosopher even earlier. Many people only arrive at an inductive philosophy of life by the time it is too late to make use of it for themselves; it becomes too retrospective to be serviceable; it has lost all present or prospective value.

The wise man profits by the experience of others, by experience at second-hand, gathered by such powers of observation as every scientific man ought to possess. For example, he can see that intense application to his task makes the American efficient as an engineer at an early age, but that unremitting devotion to work, especially if it be for the purpose of making money, will atrophy the cultural sensibilities that mark an educated man and deaden the humane interest in life that is the chief preservative of a youthful spirit. A man is old when he has ceased to be interested in others and their affairs. Again, one can see how the young Englishman, too devoted to sports, loses his place in the competition of life and misses his chance in the scramble for wealth, but, unless he has carried the fondness for sports so far as to sacrifice his career, he grows old without losing touch with the culture that gave charm to his youth or the wide human interest that warmed his heart in the days of his maturity. A sane compromise, we repeat, is necessary if one is to obtain the just balance that makes life successful. The wise man "sees life sanely, sees it whole". As for golf, in particular, we venture to suggest that although it may not be a game for old men only, it is a dangerous pastime for the young man on the threshold of a career, because it is so extravagant of time. A good game of tennis can be played in an hour, a swim needs only half that time; a round of golf consumes two or three hours—in effect, half a day. And when a fellow begins to make dreamlike drives and insidious approaches, he will not be content with 18 holes—his unit becomes 36 holes, or a whole day's golf. Next he enters competitions, which last for four or five days or even a week, depending on his success. That way lies disaster to a career as mining engineer, metallurgist, or geologist. To succeed in these the young man, to borrow a simile from the game we are discussing, must keep his eye on the ball—he must have singleness of purpose. He must learn to approach as well as to drive; mere strength will not suffice; there is needed a delicacy of touch in golf as there is required a refinement of tact in an engineer's dealings with those with whom or for whom he works. The perfectly executed mashie approach has its counterpart in the doings —for example—of the branch managers to whom Judge Gary addressed his sarcastic note. Indeed the experienced golfer knows that a successful approach is the most valuable shot in his bag, because it is a saver of other shots—the putts that follow. In golf, as in life, we see men make a grand start, by means of a tremendous drive in the game or remarkable abilities in the profession, and yet make a miserable score by the time they drop the ball into the last hole or are carried themselves to the nineteenth hole—the prospect-hole that ends their prospects on earth. Steadiness is needed in life as in the game; so is the good temper that enables a man to face trouble with a firm grasp on a stout niblick. We are reminded of the Scottish bishop who was playing at St. Andrews and drove his aberrant ball into a particularly bad bunker nicknamed 'Hell'. He took his niblick and with a deft stroke played the ball not only out of the sand but onto the green. The caddy remarked: "I'll be thinking beeshup, ye had better be taaking yer neeblick with ye when ye dee".

DISCUSSION

Objections to King Method of Pyritic Smelting in a Reverberatory

THE EDITOR:

Sir—In your issue of Oct. 7, Mr. E. C. King describes a proposed method of pyritic smelting in a reverberatory and asks for criticism. The scheme is certainly of sufficient merit to justify the full discussion which Mr. King invites. Besides pyritic smelting, there are several instances in metallurgy where the heat of oxidation of metallic sulphides generates a temperature high enough to carry on a smelting operation if the heat were efficiently utilized. Even in the old-fashioned heap-roasting with a period of several weeks, the ore was often semi-fused. The lump pyritic burner used in acid plants presents similar phenomena. In the Huntington-Heberlein pot and in the Dwight-Lloyd sintering machine there is plenty of heat, though on a small scale. Finally, in a copper converter with hot matte delivered, and with the gases escaping at 1,250 deg. C., the heat of oxidation is such that the temperature of the operation is kept sufficiently high.

Pyritic smelting is merely usefully absorbing the heat that the oxidation of the metallic sulphides evolves. If it is not usefully absorbed, the temperature in the focus or smelting zone is reduced below the critical temperature of the operation; or, in other words, the result is a frozen furnace.

There is at best, under present usual conditions of ore and flux, a narrow margin, unless a small amount of slag is made. As it is desired to make a large amount of slag, and thereby effect a high degree of concentration, metallurgists have to be pretty careful when doing pyritic smelting.

The following figures are calculated from data given in J. W. Richards' "Metallurgical Calculations," chapter on "Pyritic Smelting," and from the article by George A. Guess, "Pyritic Smelting," *Trans.* Canadian Mining Institute, Vol. XVIII, page 93:

Typical Charge	Calories per Short Ton
Heat of oxidation of sulphides	570,000
Heat in waste gases at 700 deg. C.	351,000
Heat in waste gases at 1,200 deg. C.	600,000

It is apparent that the margin is a narrow one.

Now, if Mr. King's design is studied, it will be noticed that the hot gases do not percolate through the charge to any extent, but rush directly over the hot slag to the exit flue. The temperature of smelting is about 1,250 deg. C., and the gases would pass into the flue at a temperature only slightly below 1,250 deg. C., or at about 1,200 deg. So, when starting up such a furnace by oil or coal, as soon as pyritic smelting without large additions of fuel was tried, the furnace would get too cold for smelting.

An inspection of the figures given above shows that at 1,200 deg. the gases from a typical charge would carry off more heat than oxidation of the sulphides evolves. There are several things that can be done: (1) Decrease the amount of flux, which means decreasing the concentration ratio. (In the calculations a ratio of 9 to 1 was used.) (2) Increase the amount of coal used. (3) Use an oxygen-enriched blast. (4) By some means increase the efficiency of heat recuperation so that the gases pass off at a lower temperature, and so raise the charge before it enters the smelting zone to a higher temperature. The two first-named ways would increase the cost of the operation, with no other benefit. The last two present a better prospect. If a method and apparatus were devised to smelt intensively, with the use of auxiliary oxygen to enrich the blast, in a small focus (as in a converter) and the charge preheated in a separate furnace to 1,000 deg. C. by the heat of the gas which escaped at 250 deg. C., the best possible conditions for regular smelting would be established. This would be pyritic smelting in two separate stages. The operator could control each stage to smooth out incidental irregularities in either stage, whereas in pyritic smelting the heating in the shaft and the smelting in the focus are linked. When the ore is smelted in the latter, more charge must descend, irrespective of whether the conditions are right or not. It is this fact that, with the narrow margin of heat units, has limited pyritic smelting in the blast furnace.

Mr. King's proposal is open, in my opinion, to the same objections in much more decided form.

Hartford, Conn. WOOLSEY MCA. JOHNSON.

THE EDITOR:

Sir—I am a farmer, but have a cousin who is a mining engineer, and he showed me your paper of Nov. 4 with the article about twelve-hour shifts on page 820. He knew I would be interested in what the doctor said about the novel suggestion of reducing the work day to eight hours and yet paying the men at the twelve-hour rate, providing they could do as much in eight hours as in twelve hours. Says I, "Is that entirely new?" "Never heard of it before," he says. "It goes to the right spot with me because we have to work our men over twelve hours in busy season, and if we could only get them to do half again as much work, we too could afford to reduce the time and pay the old wages." Says I, "How is it going to be done?" Says he, "Write to the *M. J.-P.*" Then he showed me another point—how my men, besides earning fourteen hours' wages in about nine and one-half hours, could be encouraged to keep on doing chores while resting in the evening and earn more money—that is if I was a boss that was really anxious to be of service to my men and teach them how to properly spend their leisure (and I am). Any man who can do twelve hours' work for me in eight hours I'll give extra jobs to. Of course I don't want them to slack up because it's dark. Most of them do their own cobbling, split their own wood, cut each other's hair and so on, and could be of real use. Mr. Carnegie gave our town a library. I wish he had thought about giving the laborers some kind of place where they could work in the evening. I can't quite figure out how it should

be arranged, but anything to keep them busy and earn more money. Of course, this is supposing they do their thirteen and one-half hours' work in nine hours. My cousin tells me of the clubhouse Carnegie gave the engineers in New York, and how when the lady charwomen turn them out of their downtown offices at 6 o'clock they can go there and get a sandwich or snack of something and go right to work again. I do hate to see people sitting around evenings reading the papers and smoking or playing cards, and some of these men play billiards when they are laid off.

Lodi, Calif. J. HASTINGS.

Freedom of Discussion in the Institute

THE EDITOR:

Sir—In view of the long and bitter controversy between the Mexican Government and American oil interests respecting that portion of Article 27 of the Constitution of 1917 which affects petroleum lands, it would seem expedient for technical societies to ventilate both sides of the problem if they touch it at all. But evidently such is not the opinion of the directors of the American Institute of Mining and Metallurgical Engineers, as my recent experience demonstrates.

Last July, I received with the monthly number of *Mining and Metallurgy* a bulletin entitled "Oil Laws of Latin America," by E. Schuster and Frank Feuille, Jr., as presented at the February meeting of the Institute. Finding much to criticize in the author's presentation of the subject, I wrote a discussion, which I finished and sent to New York the last of August. In a few days I received a reply from D. E. Jones, the managing editor of the Institute's *Transactions*, thanking me for my paper, which he said would be published, along with the original article, in the last volume of 1922.

Imagine my surprise, therefore, when I received from F. F. Sharpless, secretary of the Institute, the following communication:

"In reference to your discussion of the Schuster and Feuille paper, I beg to advise you that the Papers and Publications Committee has instructed me to send you the following communication:

"The discussion has been examined by the members of the committee, who appreciate the criticisms of the original paper which was presented, but the committee deems it inexpedient to publish this and the defence of the authors which would naturally follow and which they would be entitled to submit. This attitude is taken for the following reason: The paper for which the authors were asked and which it was their endeavor to prepare was to give a general idea of the existing oil land laws in the Latin American republics (without especial reference to their origin, their merits, or their consequences), and the principal value of the paper to the members of the Institute lies in the statements of fact as to the existing laws. A discussion of the origin of the laws, the social and political questions involved, the personal views of members and authors as to the merits, justice, or injustice of the laws, the committee believes will not form a useful addition to the paper at this time, regardless of the merits of any such discussion.

"The committee has not reached its decision hurriedly. It realizes that some opinions have been expressed in the paper which may not be concurred in by all members, that there are often two sides to a question, and that others have a right to their views, but it is unanimous in its view that a discussion along the lines indicated would serve no useful purpose, and has instructed me to return the discussion."

A careful perusal of this letter exhibits some strange inconsistencies in attempting to explain why a paper presented by two non-members of the Institute cannot be discussed by a member. I am first told that the authors were asked for "a general view of the existing oil-land laws without especial reference to their origin, their merits, or their consequences." If this had been the nature of the paper I should never have thought of criticizing it, but, as published, the bulk of the paper is devoted to an abuse of the Spanish system of subsoil tenure, and several of its paragraphs contain an unwarranted attack on the good faith of the Mexican Government in its petroleum legislation. And this the committee acknowledges, as the secretary states "It realizes that some opinions have been expressed in the paper which may be not concurred in by all members."

Far be it from me, a humble member of twenty-three years' standing, to dispute the opinion of the eminent body of New York members who so kindly manage the Institute for the non-resident membership. Nevertheless, I believe it may serve a useful purpose for the latter to learn occasionally what their rulers are doing in regard to the publication of the discussion of delicate subjects. In this way much literary effort will be saved the non-elect by a strict avoidance in their attempted contributions of any opinions which have been put on the prohibited index by the august Committee of Publications. ROBERT B. BRINSMADE.

Ixmiquilpam, Hgo., Mexico.

Sampling Spotty Gold Ores

THE EDITOR:

Sir—The notes of Messrs. Demond and Halferdahl on the subject of sampling spotty gold ores in the *Journal-Press* of Nov. 25 remind me of an experience I had at Kalgoorlie, Western Australia.

The Associated Northern mine, at which I was metallurgist, became nearly worked out in 1910, so the ore bins and two of the three ball mills were arranged for handling custom ore. These mills had a daily capacity of forty tons each, crushing dry through 27-mesh screens. The company bought the ore sent in on assay-value as it left the mills, after which it joined the company's ore and was treated by roasting, grinding, and cyanidation.

Though there was nothing refractory about the ores, considerable care had to be taken in sampling the rich lots. I remember one lot of 798 lb. sent in by some tributers (lessees). (We accepted anything from 500 lb. to several thousand tons.) This was a sulpho-telluride ore, containing wide bands of telluride of gold, a good deal of fine pyrite, and considerable "mustard" gold in a little oxide ore which was intermixed. This mustard gold, as mentioned by Mr. Rickard in his paper on "Tellurium" in the *Journal-Press* of Dec. 2, is spongy and the result of decomposition or oxidation of the telluride. As this was the most unusual lot of ore we had received, the whole was crushed, bagged, and carefully mixed, coned, flattened, and quartered in the usual manner. A close watch was kept for metallics on the 120-mesh sieve used for the assay sample. If any, they were collected, cupelled, weighed, and calculated. The assays, which averaged 146.5 oz. of gold per ton, agreed within 0.2 oz., which was considered satisfactory on such spotty ore.

In assaying rich sulpho-telluride ores, or concentrates therefrom, the most satisfactory method was that of simply fusing one assay ton with plenty of litharge and the usual fluxes, aiming to get a large lead button. There was rarely any dispute over assays.

Pittsburgh, Pa. M. W. VON BERNEWITZ.

Magnetometric Determinations Applied to Placer Mining

Results Obtained by This Method of Making Surveys to Ascertain Approximate Location of Mineral Concentrations—Use of Maps and Charts—Obstacles Encountered in Effort to Reach Correct Conclusions

By Arthur Gibson

THE VALUE of magnetometric examinations and determinations to define the location and extent of magnetic ore deposits, principally iron ore, has long been an established fact, but the application of this method to detect and locate mineral concentrations such as placer deposits and certain non-magnetic ore deposits is of more recent date. This article is written to illustrate the actual results attained by this method applied to placer mining and the principal obstacles to be surmounted in order to reach correct and reliable conclusions.

A complete description of the method and the instruments employed is contained in my article entitled "The Magnetometer as an Aid in the Development of Mines," published in the *Mining & Scientific Press* of Sept. 24, 1921. Additional reference is made to "Magnetic Prospecting," by Prof. W. S. Weeks, published in *Mining & Scientific Press* of Jan. 21, 1922, and "Magnetic Prospecting," by Arthur Gibson, published in "Discussion" in *Mining & Scientific Press* of March 25, 1922.

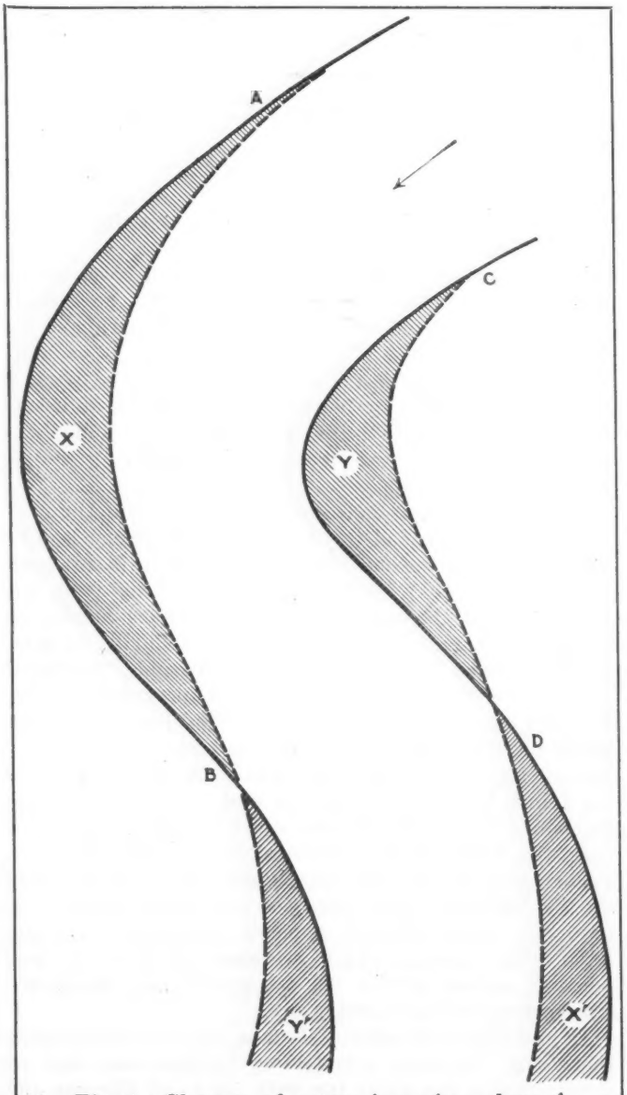


Fig. 1—Changes of course in a river channel, due to erosion.

The change of formation and course in a river channel, due to erosion or wear, is illustrated in Fig. 1. The dotted lines represent the original channel; the full-drawn lines represent the present channel and the water flowing in the direction of the arrow. The greater the volume of water or grade or both, the greater the velocity and momentum of the water and its capacity of moving gravel and boulders, throwing same against the bank on the outer curve *A—B* and gradually wearing into that bank to an extent indicated by the area marked *X*, at the same time depositing the heavy mineral concentrates along the bank on the inner curve *C—D*, on the area *Y*, where the velocity of the current is reduced and on that account unable to carry along the heavy concentrates. The main current of the river following the bank represented by the full-drawn line *A—B* receives a curved motion whereby it is deflected against the opposite bank, cutting out area *X'* and depositing the heavy mineral concentrates along the area *Y'*; this change of the formation and course of a river is repeated in all curves and bends, and bedrock is naturally wearing down deeper toward the outer curve at the same time. This is the most simple form of erosion that has been and is taking place in all rivers.

The flow of water in all rivers is never constant; it varies between the extremes—high water due to rainstorms and melting snow in the mountains in the spring, and low water during the dry season. This variable flow of water causes more or less complication in the channels and deposits of heavy mineral concentrates, illustrated in Fig. 2, which may be considered a rather simple complication, comparatively. The flow of the water in these channels has been in the direction indicated by the arrows. Straight dotted lines denote the rims of the channel, forming the banks of the river during excessive high water or floods. *A—A* is the original main channel. *B—B* is the deviation of the original channel due to erosion and wear, showing shaded areas on inner curves where heavy concentrations have been deposited. *C—C* is a secondary channel and *D—D*, a more recent channel, at a higher elevation than any one channel previously noted, with no apparent relation to channels *A—A*, *B—B*, or *C—C*.

It is easy to realize the difficulty encountered at times in distinguishing the separate channels by magnetometric determinations. The main object, however, is to define the location and limits of mineral concentrations, which is readily accomplished.

Magnetometers used for detecting mineral concentrations work on the same principle as the magnetic needle.

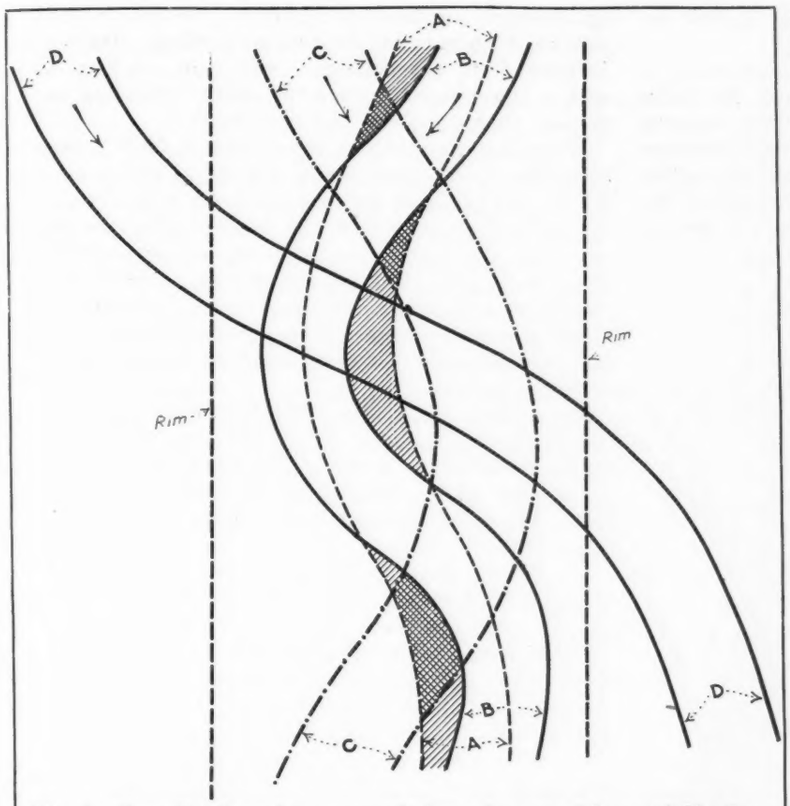


Fig. 2—Complications in course of channels caused by variable flow.

A description of magnetometers will be found in the articles previously mentioned and published in the *Mining & Scientific Press*. The instruments referred to in this article are the Thalén-Tiberg magnetometer, used for reading both horizontal and vertical magnetic intensities, and the Thomson-Thalén magnetometer, which is used for reading vertical magnetic intensities only, the latter instrument being the more sensitive of the two.

These instruments record magnetic attraction or intensity due to the presence of either magnetic minerals, such as iron-ore deposits, black iron sand in placer deposits or minerals becoming magnetic by induction, which may be due to direct contact with magnetic minerals or to the inductive effect of electrolysis in the mineral concentration.

The old theory that magnetic needles are attracted only by strictly magnetic minerals is not true. There are exceptions when the magnetic needle fails to indicate a mineral concentration; for instance, if the concentration is composed of purely non-magnetic minerals not subject to induction, or in which no electrolysis is taking place. The former condition is rare and the latter condition exists generally only in arid zones where there is not enough moisture in the ground to cause an oxidation or chemical transformation process.

In writing "this method applied to placer mining," I would not have the reader assume that magnetometers have an affinity or attraction for gold. These instruments do not indicate gold, but show positively where the mineral concentration is the greatest and where is the place to look for the best values, if any there be.

Temperature variations cause contraction and expansion in the instruments, which naturally affect the readings, more on highly sensitive than on less sensitive instruments.

Curves shown on Fig. 3 represent the variation of direct vertical magnetic intensity readings on one Thomson-Thalén magnetometer, due to corresponding change of temperature. In this case the magnetometer and thermometer were set up in a stationary and shaded position (in Shasta County, Calif., July 29, 1914), and readings were taken every fifteen minutes from 5 a.m. to 12 noon. These magnetometer readings show increase almost in the same ratio as the increase of temperature. This increase includes the diurnal change of magnetic intensity, which is small in comparison.

The curve of magnetometer readings illustrated in Fig. 3 proves the importance of making due correction for temperature variation so as to obtain true and accurate values of the vertical magnetic intensity when using the Thomson-Thalén magnetometer. The ordinary dipping needle, Thalén-Tiberg magnetometer, and some other similar magnetic instruments are not so seriously affected by temperature variations, but it follows that these latter instruments do not furnish as close results as the more sensitive Thomson-Thalén instrument.

First, a preliminary magnetometric survey is made to ascertain approximate location of any mineral deposit or concentration on the property. This can be accomplished by staking out one north and south line and one east and west line and stepping off 50-ft. distances on these where magnetometric observations are taken. The better way is to run two transit lines, one north and south and one east and west, taking magnetometric observations along them, preferably at 50-ft. measured intervals; this, however requires more time, but has the advantage of producing more accurate results for platting on charts or maps. At times it becomes necessary to run more than these two

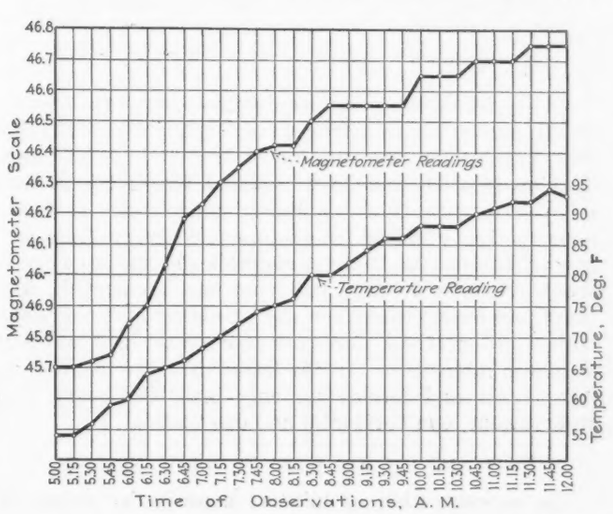


Fig. 3—Variation of direct vertical magnetic intensity readings on one Thomson-Thalén magnetometer due to change of temperature.

transit lines to make sure that no mineral deposit has been overlooked.

Second, if a mineral deposit or concentration is detected, the surface of the ground along its strike or general course is subdivided into 50- or 25-ft. squares, and magnetometer readings are taken at each intersection; readings are also taken at intermediate points when found necessary. It is always most convenient for both observations and platting to subdivide the ground into squares along true north-and-south lines.

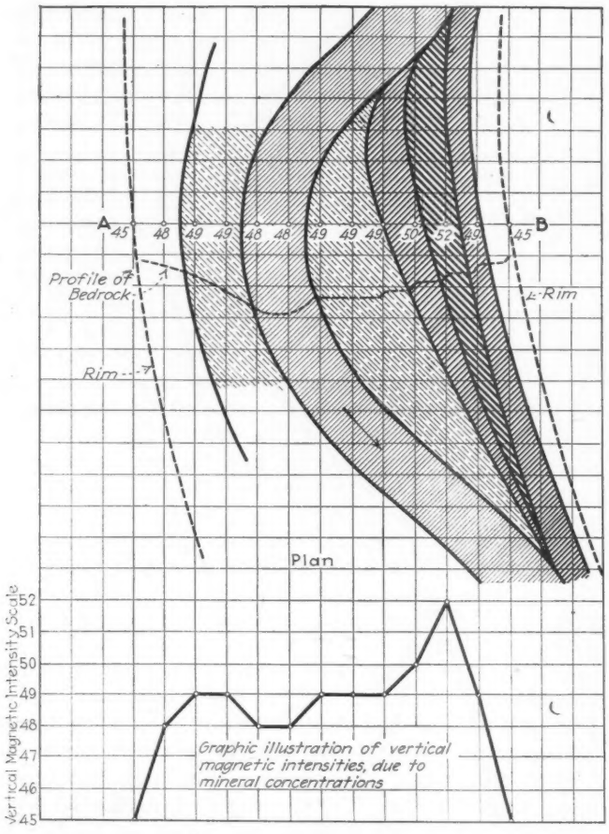


Fig. 4—Map of section of ancient river channel in Plumas County, Calif., and graphic illustration of vertical magnetic intensities, due to mineral concentrations across channel on line A—B at 50-ft. intervals.

As a rule, preliminary magnetometer surveys may be quickly made, but complete surveys require considerable time, particularly the running of transit lines and subdivision into 50- and 25-ft. squares where the ground is covered with thick or heavy underbrush or dense forest. One hundred magnetometer observations per day at stations for vertical magnetic intensities only is about the best average one man can accomplish, and about 160 observations per day at eighty stations when taking observations for both horizontal and vertical magnetic intensities. In the latter case the magnetometer is set and leveled up only once for every two observations, one horizontal and one vertical.

Maps and Charts Used to Show Results

The concentration of mineral deposits by action of water in rivers and channels has previously been described. Fig. 4 is a map of a section of an ancient river in Plumas County, Calif., which is now covered with gravel, clay, and other material, from eighty feet up to several hundred feet in depth. No trace or indication of it appears on the present surface. Its course, judging from developments, was from east to west, with a slight trend toward the south, extending under present ridges, valleys, and river beds.

Magnetometer readings were taken at 50-ft. intervals along line *A—B* crossing the channel, as shown on Fig. 4. The shaded parts indicate magnetic intensity due to the mineral concentration, the darkest being the greatest. The channel proper, with the arrow pointing in direction of flow, contains the weakest mineral concentration, due to the mineral having been carried downstream throughout ages on an immense grade of 3 per cent or more and at times by an exceptionally large flow or body of water.

The dotted line, marked "Profile of Bedrock," illustrates the gradual wear into bedrock by the action of rolling boulders and gravel. The old contention or saying among placer miners that they generally find the best values on high bedrock is readily understood from this profile.

The figures noted on line *A—B* represent the vertical magnetic intensities, observed at 50-ft. intervals, reduced to an arbitrary scale. At the foot of Fig. 4 is a graphic reproduction of these vertical magnetic intensities. The curve is made by using determined values as ordinates and distances between points of observation as abscissas. In analysing this curve we note that the heaviest or greatest mineral concentration occurs on the inside curve, in a bend or turn of a channel; the weakest mineral concentration is generally in the main or deepest channel, and as a rule the values are most evenly distributed in this part. The mineral concentration, with few exceptions, is a little stronger on the outside curve than in the main channel, owing to the frictional resistance against the bank.

Wherever complications occur due to subsequent or intervening channels, such as shown in Fig. 2, which have picked up, redistributed, and reconcentrated the original mineral concentrations, the graphic reproduction of vertical magnetic intensities becomes more or less intricate. The vertical magnetic intensities, however, along and outside of the rims of the main water-course will always remain weaker than the same intensities between the rims, no matter how erratic the curve may appear. This applies to all placer channels, except where a section of the main water-course has been washed out entirely or broken out by a slide or by volcanic action, or where the main water-course crosses another mineral deposit or concentration. Complications caused by subsequent or intervening channels affect the horizontal magnetic intensities to a far greater extent, and make them much more intricate, than the vertical magnetic intensities. For this reason I use almost exclusively vertical magnetic intensities in all exploration work pertaining to placer deposits.

Fig. 5 represents a section of an ancient river channel in Plumas County, Calif., in close proximity to channel shown on Fig. 4. Its course at this particular point is from north to south. No trace or indication of this channel can be noticed on the present surface; it extends under high ridges, valleys, and river beds, at a depth below the present surface ranging from about one hundred to several hundred feet.

Vertical magnetometric readings were taken at 50-ft. intervals along the line *A—B* crossing the channel, as shown in the plan at the top of Fig. 5. The shaded

areas indicate magnetic intensity, due to the mineral concentration, the darkest in the center of the channel being the greatest.

The vertical magnetic intensities observed on line *A—B* are graphically illustrated by a curve at the center of Fig. 5, constructed in the same manner as on Fig. 4. This curve indicates the heaviest mineral concentration in the center of the channel, explained by the cross-section of said channel at the foot of Fig. 5, showing the greatest thickness of the mineral concentration in the center of the channel. It is natural that the major portion and heaviest particles of the mineral concentration should settle to the lowest level, which is the deepest part of the channel; and, further, this curve shows an even decrease in magnetic intensity on both sides of the channel, from the center to the rims, thereby indicating a straight course of the channel, free from any bend or turn, at the line *A—B*.

Complications due to subsequent or intervening channels are rare where a channel has a straight course, as shown in Fig. 5.

Magnetometric Results Sometimes Misleading

It is only occasionally that results from a magnetometric survey will produce curves as perfect as shown on Figs. 4 and 5, which must be realized by referring to such complications as indicated on Fig. 2, and that case is by no means the most complex.

The value of this method in detecting virgin and tracing the continuation of known placer channels where they have been cut off or parted by a fault, slide, wash-out, or erosion may readily be appreciated.

Frequently, placer channels pass over ledges or mineral deposits containing iron ore or some other mineral that attracts the magnetic needle, or are found to be covered with lava which is sometimes heavily charged with unevenly distributed magnetite. In such occurrences the magnetometer readings become more or less irregular and difficult to analyze.

Fig. 6 is a graphic illustration of this condition, showing an exceedingly erratic curve of vertical magnetic intensities, observed on top of South Table Mountain, about three miles north from Oroville, Butte County, Calif. (May 4-5, 1914). Observations were taken at 50-ft. intervals for a total distance of 2,500 ft. The vertical magnetic intensities in this case range from very low to very high, due to the underlying lava being heavily charged with magnetite, and illustrate how complex magnetometric surveys may become when affected by local mineral deposits, foreign to the one under examination.

Vertical Magnetic Intensities Differ With Localities

The vertical magnetic intensity scale that I have adopted for my instruments has an absolute zero or base, but every different locality on the globe has a different base, which is the lowest value of the vertical magnetic intensity obtainable in each individual locality. A reading indicating the base or minimum vertical magnetic intensity in one locality may be as high as or even higher than the maximum vertical magnetic intensity in another locality. The former locality, however, with its comparatively higher vertical magnetic intensity but minimum local vertical magnetic intensity, does not, as a general rule, indicate any mineral concentration whatsoever at that particular place, whereas the latter locality, with its comparatively lower vertical magnetic intensity and maximum local vertical magnetic intensity, may contain an unusually heavy and extensive mineral deposit or concentration.

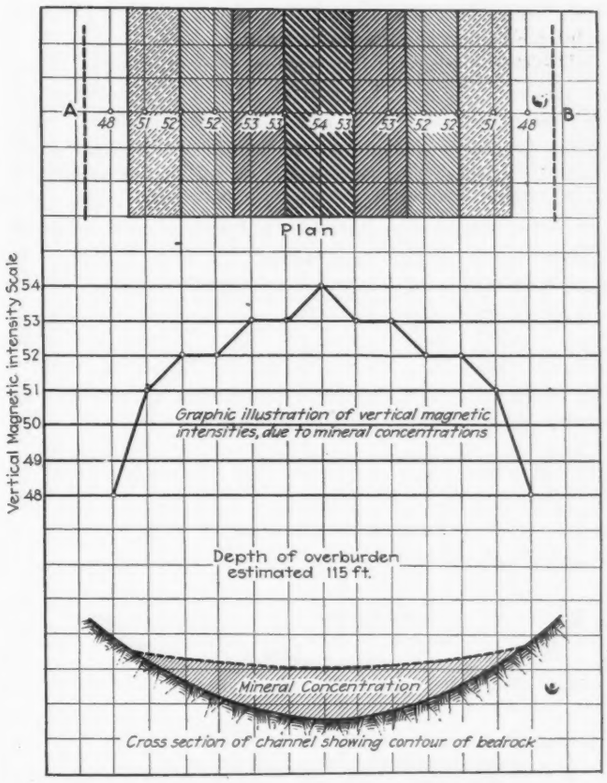


Fig. 5—Plan and section of ancient river channel in Plumas County, Calif., and graphic illustration of vertical magnetic intensities, due to mineral concentrations at 50-ft. intervals.

A few magnetometer observations in any one locality do not signify anything. The larger the number of magnetometer observations and the larger the area covered, the wider the range between maximum and minimum local vertical magnetic intensity, the better the work and the closer the results that are obtained. In some localities this range increases or decreases more rapidly than in others. These features are virtually eliminated in localities free from disturbing elements

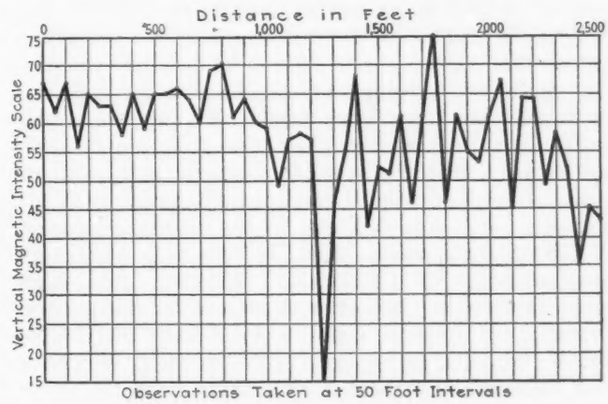


Fig. 6—Erratic curve of vertical magnetic intensities observed on South Table Mountain, California.

and where the earth's normal magnetic field is the only attraction upon the magnetic needle.

Fig. 7 is a graphic illustration of comparative values of vertical magnetic intensities due to mineral deposits or concentrations in a few different localities. The range between maximum and minimum vertical magnetic intensities in a few localities, as shown on Fig. 7, applies only to a limited area in each case. The total range for more extensive areas will naturally be greater. However, the range represented by Fig. 7 serves to give a fair idea of the relative variations.

The magnetometer observations in the vicinity of Nome, Alaska, were obtained over a larger area than the other localities referred to on Fig. 7, which explains the greater range between maximum and minimum vertical magnetic intensities at Nome.

The vertical magnetic intensities for Butte County Table Lands (Lava Beds) on Fig. 7, ranging from 15 to 75 on the vertical magnetic intensity scale, is the same identical survey represented by Fig. 6 and previously described.

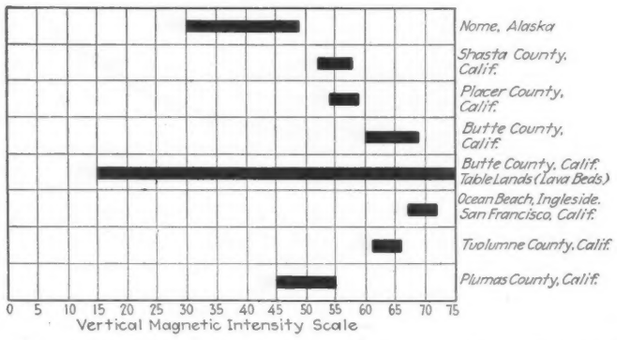

Nome, Alaska
Shasta County, Calif.
Placer County, Calif.
Butte County, Calif.
Butte County, Calif. Table Lands (Lava Beds)
Ocean Beach, Ingleside, San Francisco, Calif.
Tuolumne County, Calif.
Plumas County, Calif.
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
Vertical Magnetic Intensity Scale

Fig. 7—Graphic illustration of comparative values of vertical magnetic intensities, due to mineral concentrations, in various localities.

The high vertical magnetic intensities on Ocean Beach, about one mile south from Ingleside, San Francisco, Calif., must be due to an iron-ore deposit, as the beach formation at that place contains a great deal of black iron sand.

Magnetometric Surveys Lead to Valuable Information

It is rather strange that the vicinity of Nome, on Seward Peninsula, Alaska, should show such weak vertical magnetic intensities compared with various localities in California, not on account of the prevailing opinion that Alaska is such a highly mineralized country, but because of its being so much closer to the magnetic north pole. We know, when considering only the earth's neutral or normal magnetic field, free from any disturbing element, that the vertical magnetic attraction or intensity on the northern hemisphere is greatest at the magnetic north pole and least at the magnetic equator, so that this phenomena must be due to a very high mineralization in California. Whether this high mineralization in California is caused by the general formation of mineral deposits, by widely distributed iron-ore deposits, by minerals at deeper levels than have been disclosed by present developments, or is the result of some other cause, is a problem well worth close investigation.

Referring to the Tertiary gravel channels in California, we note on Fig. 7 that the vertical magnetic intensities are much greater in Butte County—at the foothills—than in Plumas County at high altitudes, a condition which we would expect to be reversed, because the source of the mineral deposits and the channels is in the higher mountains, the flow of the channels having been westerly or southwesterly from Plumas County toward Butte County.

The magnetometer observations in Butte County were taken north of and close to Oroville, where the vertical magnetic intensities increase going north and east—that is, toward La Porte, in Plumas County. The magnetometer observations in Plumas County were taken on the Maxine Mining Co's property (Sec. 14, T. 22 N., R. 9 E.—M. D. M.), about ten miles north from La Porte, where the vertical magnetic intensities increase going south and west—that is, toward Oroville. The fact that the vertical magnetic intensities increase from Oroville toward the Maxine mine, and likewise increase from Maxine mine toward Oroville, proves conclusively that the heaviest mineral concentration will be found between these two places. The grade of the ancient Maxine channel was found to be slightly in excess of 3 per cent, which is an enormous grade for a large river when we consider that the grade of a small ditch cannot exceed 1 ft. per 1,000 ft., equal to one-tenth of 1 per cent ($\frac{1}{10}$ of 1 per cent) before the velocity of the water increases sufficiently to wash and cut out the ditch banks.

The altitude of the region at the Mixine mine is approximately 5,500 ft. and the distance from the Maxine mine to Oroville or the foothills in Sacramento Valley is more than fifty miles. Thus, if the 3 per cent grade, approximately 160 ft. to the mile, should continue through for fifty miles, the difference in elevation would be 8,000 ft., which would place the river 2,500 ft. below sea level at Oroville, which we know is not the fact. Consequently, this grade must decrease and flatten out before it reaches the valley floor. However, there are several faults which to a certain degree will make up for the steep grade. Past developments on similar channels have proved a lighter average grade in lower altitudes. As a rule this decrease in grade is not gradual but in steps or benches alternating flat and steep. The velocity and force of the water on steep grades is naturally great, carrying along the heaviest mineral concentrates, whereas on the light grades the velocity and force of the water is checked, and the heavy mineral concentrates drag behind and even accumulate in large quantities at favorable places where the grade is so light that the water fails to move them. This is one reason for the increase in vertical magnetic intensities between Oroville and La Porte.

The decreasing grade in these ancient auriferous river channels, with the consequent increased mineral concentrations, as previously explained, between the summit of Sierra Nevada Range on the east and Sacramento and San Joaquin Valley floors on the west, can affect only the maximum vertical magnetic intensities along the ancient river channels and can have no bearing on the increase of minimum vertical magnetic intensities nor on the ground beyond the limits (rims) of those channels. The increase in minimum vertical magnetic intensities, previously described as the base for vertical magnetic intensities in each individual locality, must be due to heavy mineral deposits or concentrations in the solid formation, such as lodes or veins. The

solid formation in this section of California is rarely exposed, but is generally covered with a thick overburden, dense forest, or thick underbrush, which prevents a direct geological examination of the solid formation. However, this problem can easily be solved by a more extensive magnetometric survey than I have so far accomplished.

During the summer of 1921 I was called to the Maxine deep gravel mine on the South Fork of Feather River, Plumas County, Calif., about ten miles north of La Porte. Two different mining companies had previously failed to make a success of this property, and the present owners found themselves in the same predicament. The magnetometer survey disclosed an ancient river channel containing heavy mineral concentrations, south of and close to the Maxine shaft, between 450 and 500 ft. wide, extending from east to west, with a slight southward trend; and on the surface above the old workings, a mineral concentration in the form of a large eddy or whirlpool, north of and alongside the ancient channel. The Maxine mine was flooded at the time, but after it was unwatered it was proven conclusively that the old workings were confined within a large eddy of the main channel. A tunnel was driven south from the old workings, and the main channel was tapped. The values as well as the average depth of pay-gravel proved to be a great improvement over the old workings.

The magnetometer survey further disclosed the existence of two additional ancient river channels in close proximity, 450 and 500 ft. wide respectively. These channels have not yet been developed, and the values they contain are therefore unknown, but the magnetometer readings indicate a stronger mineral concentration in both of these channels than in the one mentioned that has been developed, so that the prospects are favorable for even better or higher values in these two channels.

The gravel in the Maxine mine is similar to the gravel in the old workings at La Porte, but it is doubtful if it is one and the same channel. The surface at La Porte is 500 ft. lower than at Maxine mine; the distance between these places is ten miles, and the drop of the Maxine channel in ten miles on 3 per cent grade, approximately 160 ft. per mile, is 1,600 ft. The continuation of the Maxine channel therefore should pass La Porte at 1,100 ft. lower elevation. The possibility of one or more faults between these two places might make up for the difference in elevation, but this can readily be determined by additional magnetometer surveys.

Mica Industry of Guatemala

As a result of development work now in progress, Guatemala, although at present a small producer of mica, may become an important exporter of this mineral. The United States requires four times as much mica as it produces and Guatemala should readily find in the United States a market for all that it can export in the future, says Consul A. C. Frost in *Commerce Reports*. Interested American firms may obtain copies of a detailed report on the Guatemalan mica industry by application to the Iron and Steel Division, Bureau of Foreign and Domestic Commerce, Washington. Reference, in communications to the bureau, should be made to file No. 73,003.

The Webster-Dosenbach Decision

So-Called Webster Process of Floating Copper Precipitated From Leach Solutions Upheld by Court of Appeals

METALLURGISTS have been interested in the conflicting claims of Messrs. Webster and Dosenbach as to who was the pioneer in what has come to be known as the Webster process. The first decision of the U. S. Patent Office was in favor of Webster; the case was then carried before the Court of Appeals of the District of Columbia, which has recently upheld the first decision. The invention is described as

"A process for treating copper ores and particularly those known as oxide ores which are not susceptible of concentration by the flotation process commonly used with sulphide ores. The process consists in grinding the ore, treating the ground material with sulphuric acid to dissolve the copper present in the ore, introducing metallic iron, which combines with the copper sulphate, forming iron sulphate and precipitating the copper, and in separating the precipitated copper by concentration, by gravity or by flotation."

A summary of the claims of Dosenbach, as reported in the *Patent Office Gazette*, is as follows:

"Appellant Dosenbach claims to have conceived and reduced the invention to practice in November, 1914, while Webster claims to have conceived the idea of concentrating the ores and precipitating the dissolved metal into the pulp in October, 1914. The parties, however, seem to differ as to the real gist of the invention here involved. Dosenbach's conception seems to have been limited to the idea of separating the metallic copper from the ore by flotation, while Webster seems to have directed his energies toward the process of precipitating the copper in a metallic state to be separated by some known process. On this point we agree with the commissioner that precipitation is the essential step in the invention and that

flotation might be replaced by some other method of concentration without destroying the process in issue.

"We think, therefore, that Dosenbach has failed to show even conception of the essential feature of the invention in issue on the dates claimed by him. On the other hand, Webster's dates are well corroborated and his efforts were directed to the development of the invention of the issue. Indeed, the present contention of Dosenbach that separation by flotation constitutes the chief feature of the invention is not consistent with his original specification wherein he seems to treat the matter of flotation as a secondary feature. In his specification he states—

my process is not restricted to the use, or non-use, or the use of any particular floating agent, and includes the operation regardless of whether the flotation be affected by the addition of frothing agents or by the properties imparted to the pulp by the various salts formed in the leaching operation.

"He also refers in his specifications to effecting flotation 'in any of the well-known forms of apparatus. . . . or by means of jets' as illustrated in the prior art.

"Without stopping to review the testimony, we are of the opinion that Webster . . . has clearly established his claim to priority."

A second case before the court was similar, except that Dosenbach claimed that Webster's patent did not cover the process when applied to ores containing sulphide copper. This also was decided in favor of Webster, the court stating:

"We are not impressed with this contention since the evidence discloses that the process was invented by Webster to solve the problem of treating ores from Bullwhacker mine, at Butte, Mont., and that this ore, while predominantly oxide, contained sulphide copper. It also appears that Webster had made considerable study of the most approved methods of flotation, and that the ores treated by him at the East Butte mine were sulphide copper."

It is understood that the Merrill company, of San Francisco, has the Webster process under its wing.

Dust in Milling Plants

A Little Care and Thought, and Inexpensive Housing and Equipment Eliminate Most Discomforts From This Cause

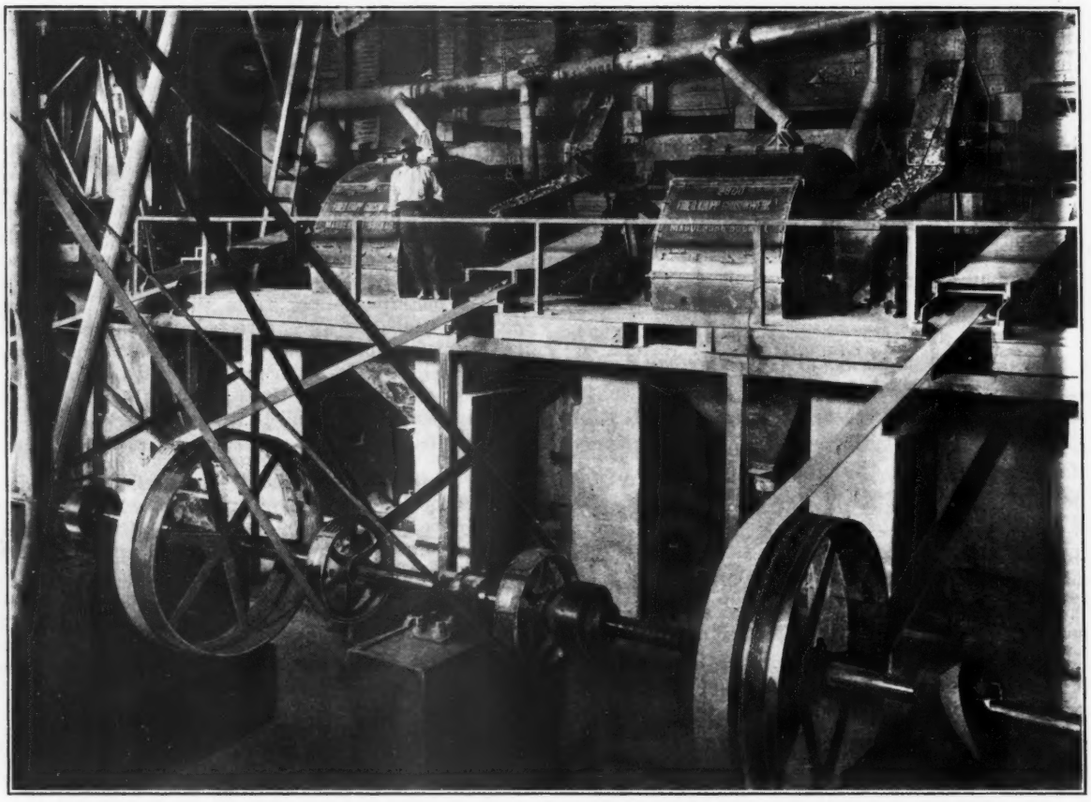
By M. W. von Bernewitz

AN EDITORIAL on dust in milling plants in the *Journal-Press* of Aug. 12 reminds me of my experience in Western Australia and New Zealand mills, wherein I inhaled a goodly quantity of dust, and perhaps my notes may be of interest, and suggestive.

The sulpho-telluride ores of the "Golden Mile," at Kalgoorlie, are naturally dry, the driest carrying 0.5 per cent moisture. (All millmen will admit that over 1 per cent of moisture is a nuisance in dry milling operations.) The silica content was as high as 75 per cent. Dry crushing and roasting, followed by cyanidation more or less as at the Golden Cycle mill, at Colorado Springs (whose metallurgist might give his experience with dust), was the process in vogue at six mines treating a total of 2,000 tons of ore daily. In addition to these, several concentrating plants had furnaces for roasting concentrates. A study of the different machines employed, and the manner in which the dust was suppressed, should be worth while.

When rock breakers are fed with ore direct from skips from the main hoisting shaft, the rush of ore over the grizzly results in a cloud of dust, which, if the breaker be inclosed, hangs about most of the time. Most of the breakers were in the open—that is, they had a high roof, but the ends of the structure were open, so the wind blew the dust away. It may be argued that much valuable dust is lost if a crushing station is open to the wind, but on low-grade ore this is of small consequence, and the health and comfort of attendants is improved. The undersize passing through the grizzly into bins also makes considerable dust. When skips or mine cars are dumped into bins, from which the ore is drawn steadily to rock breakers, conditions are much improved. The broken ore, flowing out of chutes onto belts, throws off a good deal of dust, but at such points the conveyors could be covered with a hood supplied with an exhaust. If ore is to be milled wet, there is no reason why it could not be sprayed slightly with water, in summer time at least.

Conveyor belts discharged the broken ore into mill storage-bins, and when these were kept well filled there was not much dust, but when low there was a considerable quantity, on account of the ore dropping a distance of 10 to 30 ft. When the ore in bins becomes low from



Ball-mill section of a 120-ton dry-crushing plant at Kalgoorlie, Western Australia

At the far side of No. 1 mill is the fan. The branch suction pipes to the mills are plainly shown. The vertical pipes behind the mills are for cleaning out the main pipe. The pipe from the top left corner to the bottom left is for drawing off hot dust where a conveyor feeds into the chain-and-bucket elevator. The dust house is at left rear.

some cause, and will not flow to mill feeders, shoveling is often resorted to—a somewhat dusty occupation.

All dry-crushing mills are naturally dusty, even when inclosed in tight-fitting casings; but they may be made almost dustless with care. A Griffin mill, Krupp ball mill, disk crusher, and others are dusty, but if the casing be connected by means of light sheet-iron piping to a fan, there should be practically no dust arising therefrom. That was our experience at Kalgoorlie. Stop the fan for a moment and dust arises in clouds. A fan is really necessary for the better working of such a machine, the protection of bearing and other machinery from dust, and the comfort of the attendants. With fans of the Sturtevant type, a 36-in. machine, driven at 1,000 r.p.m., should draw off the dust from six large mills. The capacity in this case should be at least 5,000 cu.ft. per minute. The suction pipes from the mill casings should not be less than 9 in. in diameter, connected to an 18-in. main, which should be provided with V-traps and gates for collecting accumulated dust.

Fans blow the dust into collecting houses or into cyclone arresters. A good style of dust house is that made of 2x4-in. lumber, and covered with close burlap. A double house—that is, one within the other—is a thoroughly efficient dust catcher. Bottoms should be V-shaped, with a screw conveyor and gates in the bottom of the trough for discharging, so that men need not enter the house for cleaning purposes. A punkah-like arrangement (a light frame which may be swung by ropes running through the walls to the outside), such as used in smelter baghouses, may be used for knocking off dust that builds up on the walls. If cyclone arresters are employed, the effluent dust may be conducted into a furnace flue.

In the conveyance of raw, dry-crushed ore, both screw and push conveyors are used. The former work well if they are properly attended to, and have a tight-fitting cover which lets out little or no dust. Push conveyors are all right, but a special covering must be affixed to keep down the dust.

Belt-and-bucket elevators lift the crushed ore from conveyors to the fine-ore storage bins, and both elevators and bins can be made almost dust-proof without much trouble. If built of wood, they should be double lined; and if of sheet iron, they should be bolted or riveted with felt joints. If left undisturbed, all corners and small openings in conveyors, elevators, and bins naturally become sealed by the dust collecting within them, thus preventing its exit into the plant.

If roasting furnaces are close to or under the fine-ore bins, little dust is made in feeding the former; but when some distance away, push or screw conveyors are used, and these make a certain amount of dust. Furnace feeders make no dust at all. Where one push conveyor feeds another at right angles, a hood or upcast should be fitted to carry off dust made by the ore dropping from one to another. Furnaces make no dust excepting at the discharge end, where the roasted ore drops into coolers or push conveyors. If the drop is over 12 in., considerable dusting results at each discharge, and to minimize this, the fall may be broken by means of staggered plates. Push conveyors are excellent for conveying raw or roasted ore, but make a good deal of dust. At each stroke, the blades or flights strike the ore, carry it along 12 to 18 in., the heaps thus formed falling back a little, while the blades on the back stroke drag over them, creating more disturbance. Such conveyors should be covered as tightly as possible. Where these conveyors discharge their load with chain-and-bucket elevators, a large hood connected to an exhaust fan should be provided. An 18-in. fan drawing off 600 cu.ft. a minute suffices for a conveyor carrying 200 tons of fine ore in twenty-four hours. The dust may be collected in cyclone arresters.

Chain-and-bucket elevators, if well constructed of plate and angle iron, make little dust, and may be kept clean by means of a fan where they discharge. Pits in which the boot of an elevator is fixed should always be roomy, and as shallow as possible.

Dust is always worth saving and treating, as its value is equal to or greater than the ore being milled. At least, that was our experience at Kalgoorlie and Waihi. A mixture of raw and half-roasted dust is somewhat difficult to treat, but if gradually mixed with the current mill flow of ore to the furnace it has no effect on subsequent treatment.

Wind has a great deal to do with the clarity of the air in a dry-crushing plant. On a hot, still day, dust hangs about; but with a good breeze the air in the building becomes very clear, so that if possible, when designing a plant handling dry ore, buildings should be made as open as possible. It may be cold in winter for employees, but cold is preferable to lung affections.

I have said nothing of respirators to be worn by millmen, because, even if they were provided, the men detest them and rarely wear them.

Italy's Sulphur Exports Go Chiefly to Neighbors

Italian sulphur exports are confined almost entirely at present to European countries and the eastern Mediterranean, says a writer in *Commerce Reports*. Antiquated methods of extraction in the Sicilian mines, combined with high daily wages paid to ineffectively utilized labor, have resulted in generally high cost of production. Consequently, many former markets have been lost in whole or in part to American sulphur exporters, despite the disadvantages for the latter arising from the comparative levels of dollar and lira exchange. During the nine months ended with March, 1922, Italy exported 54,402 metric tons of sulphur, valued at 44,666,740 lire, the amount shipped in the first quarter of 1922 being 36,434 tons, valued at 29,493,350 lire. Greece was the leading purchaser of Italian sulphur in the first three months of the current year, taking 16,280 metric tons. followed by France, with 4,344 tons; Germany, 2,860 tons; Smyrna, 1,588; Asiatic Turkey, 1,544; Austria, 1,340; and Yugoslavia, 1,045 tons.

Soapstone Deposit in Ontario

The organization is announced of the Wabigoon Soapstone Co., Ltd., with a capital of $500,000, to mine soapstone in the Wabigoon district, about 200 miles northwest of Fort William, in Ontario. The company is said to own a large deposit of soapstone, which is claimed to be the only deposit in Canada that can be worked commercially. Samples of the soapstone are reported to be of a greenish color, easily worked, and of excellent quality. The development of the industry will be of interest to pulp and paper companies which use this stone for lining kraft-mill furnaces and pulp digesters. It is also used extensively in the electrical, rubber goods, and other industries.

An Investigation of Losses in Copper Blast-Furnace Slag—II*

Electric Furnace Used in Fusion and Settling Experiments—Constant Copper Loss as Dissolved Sulphide Varies With Grade of Matte—Gold in Slag Entirely Due to Prills of Matte—Probable Losses With High-Grade Matte Calculated

BY D. F. STEDMAN
Chemistry Department, University of British Columbia, Vancouver, B. C.

AN ELECTRIC FURNACE of a type shown in Fig. 6 was constructed for the purpose of carrying out some fusion experiments. This was essentially a resistance furnace using Kryptol as the heating element, with 1½ in. of sand as heat insulation. The early experiments were made in a coke furnace consisting of a coke bed 15 in. deep, with the crucibles buried in the top. As the slag was fused in assay crucibles, only comparatively low temperatures could be used, which necessitated fusing samples for a long time to be sure that equilibrium was established—about two hours being allowed. The temperature attained in the Kryptol furnace was probably between 1,350 and 1,400 deg. C., using the approximation that slag is liquid at 1,100 deg., but this figure is only an estimate, and individual fusions probably varied widely. In this furnace glazed porcelain crucibles were used, which permitted running at much higher temperatures, without excessive corrosion. It was decided to ignore the effect of corrosion on the composition of the slag, as on looking up operating figures on different slags it was seen that any error introduced would be negligible. Throughout the work the microscope was found to be extremely useful in following operations of every kind; thus, in checking up the silver-nitrate method of estimating prills, final conclusions were based entirely on the behavior of a sample of slag under the microscope. It was also used throughout the work to check up fusions as to the absence of prills and surface oxidation.

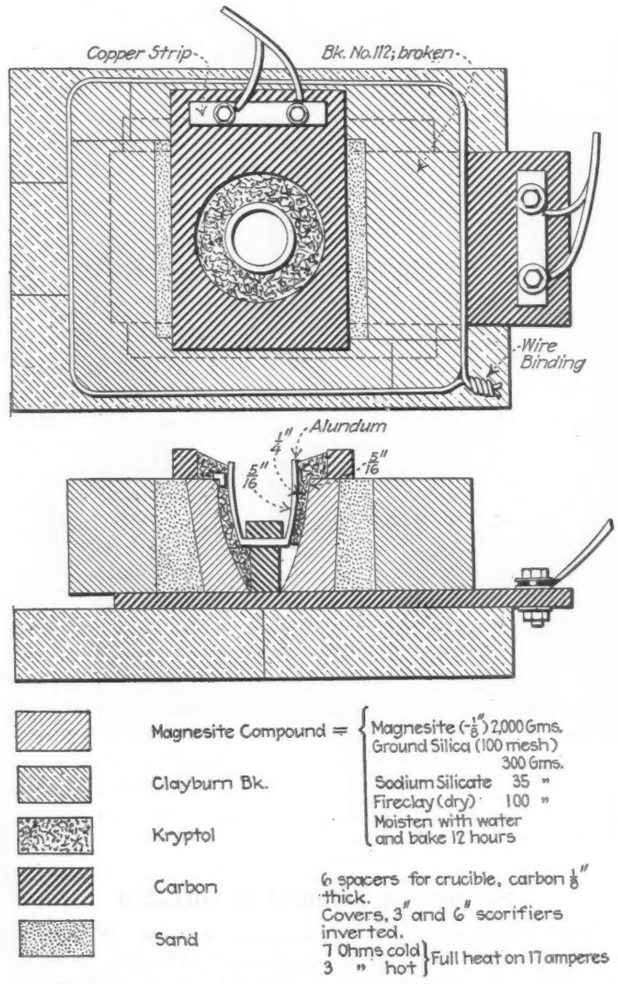


Fig. 6—Kryptol resistance furnace.

EXPERIMENTS ON CONVERTER SLAG

The appearance of converter slag when polished and viewed under a microscope is markedly characteristic, consisting of three materials only: large bright crystals, usually elongated and parallel to each other, between which are numerous distorted sulphide prills (not circular), and the whole is filled in with brown slag, except for a considerable number of gas bubbles. The bright crystals were evidently formed while the slag as a whole remained liquid, in the form of a highly interlaced network, which prevented the matte globules settling. Combined magnetic separations and hydrofluoric-acid treatments proved these crystals to be magnetite, and finally a small sample was isolated, analyzing 1.5 per cent silica, the rest approximately magnetite, and only 0.35 per cent copper. This material was used in testing the pyrogallic-acid and sulphur-dioxide method discussed before. The matte prills had evidently never had sufficient freedom to settle, and if such slag were poured into a comparatively cool blast-furnace settler, it is easy to understand that the loss in the blast-furnace slag itself would be increased, although most of the matte prills from the converter slag would probably settle, being very large. According to Maier and Van Arsdale, the evolution of sulphur dioxide will also increase the loss, as well as the partial choking action of the magnetite.

On fusing converter slag, the whole fusion boils and gives off sulphur dioxide in considerable amount. After fusion (till quiet) the slag still shows much magnetite and prills, and no matte button settles, but the prills are all oxidized to "white metal," clear blue under the microscope (showing that ferrous sulphide is oxidized to sulphate rapidly, but cuprous sulphide only very slowly). But if converter slag is fused with pyrite or with nails, a matte button immediately forms, in both instances containing copper (by microscope), and the magnetite disappears.

The silver-nitrate method, when applied to converter slag, dissolves about 90 per cent of the copper, and under the microscope this reagent precipitates silver practically all over the surface (except on the magnetite

*Part I of this article appeared in the *Journal-Press* of Dec. 9.

crystals), even where no trace of prills shows under the highest power, giving exactly the same appearance as seen with the sample known to contain copper silicate. As copper sulphide could hardly be present in such amount in an invisible form (cf. blast-furnace slag), and would hardly give this appearance if it were, the copper which is attacked here is almost certainly silicate, together with the matte prills. The copper loss is, thus, as matte prills, dissolved copper silicate, and probably, by analogy from blast-furnace slag, a small amount of dissolved copper sulphide, but not more than 0.5 per cent of the latter.

Experiments on Blast-Furnace Slag

If a sample of blast-furnace slag is polished and etched lightly with hydrofluoric acid (1:20), and viewed under a microscope, sulphide prills are visible, in every instance except when very minute, attached to a gas bubble—the cause of their flotation. But only a few small magnetite crystals can be seen. As slag oxidizes so easily when molten, this seemed to indicate almost entire lack of oxidation, in which case the slag should be practically in equilibrium with the matte. This condition of equilibrium can be duplicated in the laboratory, provided proper care be taken to prevent any oxidation.

The methods of eliminating oxidation adopted by different experimenters have been: (1) Inclosing the fusion in an assay furnace. This might or might not maintain a reducing atmosphere, and in any event what the figures obtained actually represent is rather uncertain. (2) Maier and Van Arsdale use a layer of calcined charcoal on the surface of the slag. This invariably produces metallic iron, containing copper, not only in a film on the charcoal but in fine branches extending some distance into the slag. This would probably reduce the copper in proximity to the iron, but would increase the chance of salting the slag with copper-containing material. (3) The method used in the first experiments detailed (Tables I and II) was to cover the crucibles with inverted scorifiers, and bury the whole with small coke.

Slag-Matte Equilibrium Experiments with Varying Grades of Matte

To find the copper loss in a slag when at true equilibrium with different grades of matte, the slag was fused with 10 per cent by weight of 1-in. pyrite, 11 per cent of matte, 48 per cent of matte, 60 per cent of matte, and artificial copper sulphide, (74 per cent of copper). The slag was broken to about ¼ in., mixed with the particular matte, and kept fused for about two hours in the coke furnace. The temperature used was high enough to cause many of the assay crucibles to collapse entirely, and those surviving were all softened considerably. The results of these experiments are given in Table I.

To check these values as representing complete equilibrium, a number of experiments were made at Trail, using different methods to eliminate oxidation and different starting materials, as shown under experiments 1 to 4.

Experiment 1—A mixture containing considerable oxidized copper and magnetite, from 10 parts blast-furnace slag and 1 part converter slag, was fused with different sulphides for about an hour in the coke furnace. The time of fusion was limited, as the slag is very much more corrosive than furnace slag alone. The results obtained are shown in Table II.

TABLE I—SHOWING METAL CONTENT OF SLAGS FROM FUSION OF TRAIL BLAST-FURNACE SLAG WITH VARIOUS GRADES OF MATTE

Material Used in Fusion	Total Cu in Slag	Cu Sol. in $AgNO_3$ (Prills)	Diff. = Dissolved Cu	Cu in Matte	S	Au
Original slag	0.135	0.034	0.101	.....	0.58	0.014
Original matte	.....	.....	.....	11.6	.....	.....
1. Slag + pyrite	0.035	.....	.....	.....	0.63	0.008
Matte button	.....	.....	.....	1.21	....	0.12
2. Slag + pyrite (best sample obtainable)	0.033	0.005	0.028	.....	0.70	.....
3. Slag + matte (11 per cent)	0.21	0.11	0.10	.....	....	.....
Matte button	.....	.....	.....	12.1	....	.....
4. Slag + high-grade matte (48 per cent)	0.46	0.16	0.30	.....	....	.....
Matte button	.....	.....	.....	45.1	....	.....
5. Slag + high-grade matte (60 per cent)	0.45	0.15	0.30	.....	....	.....
Matte button	.....	.....	.....	56.44	....	.....
6. Slag + artificial Cu_2S (74 per cent)	0.51	0.16	0.33	.....	0.80	.....
Matte button	.....	.....	.....	64.2	....	Fe 7.8

Slags 3 to 6 partly crystallized, Cu soluble in $AgNO_3$ probably too high, but not more than 0.01 to 0.04 per cent. The values of this table are marked (0) in Fig. 2.

TABLE II—FUSIONS OF CONVERTER AND BLAST-FURNACE SLAG WITH PYRITE

Material Used in Fusion	Total Cu in Slag	Cu Sol. in $AgNO_3$ (Prills)	Diff. = Dissolved Cu	Cu in Matte	Au
Original blast-furnace slag	0.145	0.027	0.118	....	0.020
Original matte	.....	.....	.....	12.	.....
Converter slag	3.3	.....	.....	....	0.52
1. Slag + iron flotation tailing	0.092	0.016	0.076	....	.....
Matte button	.....	.....	.....	2.5	.....
2. Slag + ⅛-in. pyrite	0.130	0.015	0.115	....	0.009
Matte button	.....	.....	.....	3.4	0.77
3. Slag + lump pyrite	0.140	.....	.....	....	.....
Matte button	.....	.....	.....	1.5	.....

These slags were evidently not at equilibrium, shown by the successive decrease in slag copper on using finer sulphides.

With ⅛-in. pyrite the slag was reduced from 0.48 to 0.115 per cent copper, whereas the ultimate figure is about 0.03 per cent (see Table I)—i. e., under these conditions only one-fifth of the excess copper is left unreduced. Applying this to the previous fusions, only one-twentieth of the excess copper should have been left unreduced (⅛ ÷ 2 ÷ 2), as the time of fusion was double, and magnetite probably less than half. (And temperature considerably higher.) This small amount of copper may be considered negligible so far as this work is concerned.

All further experiments were made in the electric furnace, using porcelain crucibles, permitting the use of temperatures more nearly approaching that of a blast furnace, and reducing necessary time of fusion. Sometimes in making the experiments here described reliance was placed on the reducing atmosphere maintained by the furnace, and sometimes nitrogen displacement was utilized to prevent oxidation. The nitrogen was made from NH_4Cl and KNO_2, and passed through alkaline pyrogallate and concentrated H_2SO_4 immediately before using.

Experiment 2—The copper silicate slag described under $AgNO_3$ method was fused with one-tenth of its weight of fine pyrite, in the furnace atmosphere.

Original slag, 1.45 per cent Cu.

Final slag, 0.125 per cent Cu. Matte button, 11.2 per cent Cu, which checks quite well with the figures first given, only 2 per cent of the excess copper remaining, although the entire slag content was known to be present as silicate in the original slag.

Experiment 3—This was an extremely careful fusion of slag with high-grade matte (40 per cent). This experiment, with one described later (4b), was about the most carefully conducted of the whole series, using entirely

fresh materials, except the slag, and a very high temperature:

Slag, 0.30 per cent Cu. Matte, 39.4 per cent Cu.

Oxidation was absolutely eliminated, the surface of the slag being as bright as a fracture, and a long enough time was allowed.

Experiment 4—These were fusions with low-grade matte.

a. Slag fused with 12 per cent matte, clayed up in crucible. The fusion was much oxidized at first, and, to prevent this, charcoal was scattered on the clay cover. This fusion was made at rather too low a temperature, but, disregarding the speed of oxidation, little or no copper silicate was formed; otherwise the low temperature would have left the slag too high.

Slag, 0.23 per cent Cu. Matte, 38.6 per cent Cu.

b. Slag fused with 12 per cent matte, in double crucible, with fine charcoal between. Probably the best figure obtainable on low-grade matte.

Slag, 0.09 per cent Cu. Matte, 12.0 per cent Cu.

c. Slag fused with 12 per cent matte, nitrogen displacement of air:

Slag, 0.12 per cent total Cu
0.015 per cent prills
0.105 per cent dissolved Cu.
Matte, 12.3 per cent Cu.

These figures all check well with the series obtained in the coke furnace (Table I), except that indications are that the two highest-grade figures are rather too low. The high-grade figures do not agree as well as might be desired, but this is probably due to the variation of conditions, especially of temperature.

When these figures are compared with those given by Lathe and Maier and Van Arsdale (Fig. 1)[1] considerable variation is seen. Their plots are given with those resulting from the Trail experiments for purposes of comparison. Considering that by Maier and Van Arsdale first: When they used 10 per cent of copper-free ferrous sulphide, their slag was only reduced to 0.18 per cent copper, whereas in the Trail experiments the slag was reduced to 0.033 per cent. As their slags were fused for four hours in a reducing atmosphere, equilibrium must have been established and any magnetite reduced. The only conclusion is that their sample was salted with either prills from the surface or floating in the slag, or with the copper-containing iron produced by the charcoal covers which they used, as no such large variation can be accounted for by the different composition of slag used. (In one of the Trail experiments the iron produced by carbon analyzed 3 per cent copper.) Or possibly they included the slag in immediate contact with the crucible in the sample. The inside of the crucibles becomes entirely covered with gas bubbles, with numerous matte prills entangled among them, usually of the original matte grade, not the low-grade matte produced from the pyrite. Also, they base their conclusions on the fact that the slag shows a continual decrease after fusion with copper-free pyrite, but quickly becomes constant for copper-saturated pyrite, containing 2.11 per cent copper. The pyrite can certainly not be considered saturated by 2 per cent of copper when fused, as ferrous sulphide and cuprous sulphide are miscible in all proportions. On changing their figures obtained by fusion of slag with copper-free ferrous sulphide to matte grade and slag loss, to correspond with the Trail experiments plot, the following values are obtained:

Weight of pyrite used, per cent	0	5	10	20	33
Estimated grade of matte, per cent copper	40	2.2	1.3	0.7	0.5
Slag loss, per cent copper	0.31	0.20	0.18	0.17	0.13

taking the matte grade as 100 times decrease in slag divided by percentage of pyrite used. These figures are supposed to represent a stable condition of equilibrium between the slag and matte. Taking the original materials as produced in the furnace and comparing those produced by fusion with ferrous sulphide, there is found that, in the latter case, 0.5 per cent copper in the matte forces 0.13 per cent into the slag, while the original matte of probably 40 per cent copper only forced 0.31 per cent into the slag, 80 times the matte grade and only 2½ times the slag loss. This evidently follows no reasonable law whatever. Also, any slag produced in a reverberatory furnace with a matte as low as 2.2 per cent copper under ordinary furnace conditions would certainly not carry 0.20 per cent, but only a trace. Taken altogether, their fusions can hardly be accepted as accurate.

Considering Mr. Lathe's fusions on Granby blast-furnace slag, his figures are higher than those obtained at Trail on low-grade mattes, but lower on high-grade mattes. This appeared to show that insufficient time was allowed, or too low a temperature used. Also, if his plot is produced a very short distance (and there is no indication whatever of curving), it will cut the slag axis at 0.07 per cent copper. Considering that cuprous sulphide has a considerable affinity for, or solubility in, ferrous sulphide, it would seem impossible to obtain a condition of equilibrium such as this represents—i.e., matte, 0.0 per cent copper; slag, 0.07 per cent copper. He also treated some reverberatory slag in the same manner, and the plot obtained was parallel to the blast-furnace line but cutting the slag axis at 0.24 per cent. This certainly indicates lack of equilibrium. In making high-grade mattes he mixed metallic copper with low-grade mattes, which can hardly be considered equivalent to plant operation, as the copper will remain as such, and with probably a very small solubility in slag.

Probable Condition of Copper Loss

According to Maier and Van Arsdale, in blast-furnace slag the copper is present partly as prills of matte, floated by gas bubbles, and determinable by the silver-nitrate method (on a chilled sample); and the remainder as copper sulphide dissolved in the slag, even in reverberatory and converter slags. Lathe goes to the other extreme and considers all the copper either as matte prills or copper silicate, the matte prills best determined by the gold content of the slag, and the copper silicate by treatment with hydrofluoric acid and sulphuric dioxide. Although Lathe rejects the silver-nitrate method entirely, it has at Trail given complete satisfaction, samples known to contain no prills by very careful picking, checking with the same material, but containing prills, after treatment with silver nitrate; and no discrepancies have been noticed when using it, so long as chilled samples are used. As the Bureau of Mines states that copper silicate is completely soluble in the sulphur-dioxide reagent alone, and neither hydrofluoric nor pyrogallic acid will precipitate any copper dissolved, oxidized copper in the Trail slag now being produced must be limited to 0.01 or 0.02 per cent. Also, the value for prills as determined by the silver-nitrate method will tend to be high (although methods of calculating prill copper all agree with this determination, as shown later). The difference, then, between total copper and prills plus oxidized copper must be copper sulphide dissolved in the slag, as no other combination seems feasible. This reasoning applied to the

[1]Figs. 1-5 were printed in the Dec. 9 issue of the *Journal-Press*.

slag used in previous work, a representative Trail slag, gives the following result:

Total Cu	In Prills by $AgNO_3$	As Cu Silicate by HF, SO_2 and Pyro.	Difference=Dissolved Copper Sulphide
0.135 per cent	0.034 per cent	0.01 per cent	0.09 per cent Cu

This value for dissolved sulphide checks exactly with that obtained by fusion of this slag with low-grade matte, under neutral conditions (see experiment 4*b*), so that I think the conclusions that I have drawn from results attained at Trail are correct—i.e., that there is a condition of equilibrium established between the slag and matte, producing a constant loss of copper as dissolved sulphide for each grade of matte, and I believe that the curve plotted in Fig. 2 represents this loss as accurately as possible. Mr. Lathe, in his second article, gives the analysis of a sample of slag from Trail:

Total Cu	Copper Silicate
0.255 per cent	0.03 per cent Cu

If this sample is normal and follows the Trail operating average plot (Fig. 4), it should have been made with a 25 per cent matte, and prills would be about 0.08 per cent. This slag would then contain:

Total Cu,	Prills (estimated),	Cu silicate,	Difference=Dissolved Copper Sulphide,
0.255 per cent	0.08 per cent	0.03 per cent	0.145 per cent Cu

This dissolved loss can hardly be considered the least important of the three, as Lathe suggests, although this sample may have been merely high in prills or taken under abnormal furnace conditions; but in any event this loss will be considerable.

Discussion of Gold Losses

The gold in the slag was found to be exactly proportional to the gold in the matte, when taken over a long period (see Fig. 5). On the face of it this appears to imply solubility between slag and matte, but on calculation, all of the gold (or sometimes more, using the best figures at present available) can be accounted for in matte prills, on the assumption that they carry the same ratio of copper: gold as the body of matte produced. This will probably be correct so long as prills have any ferrous sulphide left, which is oxidized before cuprous sulphide. The only error involved in this assumption is that, as the prills are on the average considerably higher grade than the matte, some small amount of copper will be dissolving in the slag as sulphide.

The calculations made were as follows:

On taking two points from the plots of operating and dissolved sulphide losses, Fig. 2 and Fig. 4, these values are obtained:

	Matte, Per Cent 12	25
Dissolved sulphide loss corresponding to matte grade, from experimental fusions, per cent copper	0.095	0.165
Average operating loss, per cent copper	0.145	0.245
Therefore the average operating prill loss, per cent copper was	0.05	0.08

These prill losses are 0.52 and 0.48 of the dissolved losses, or 0.42 and 0.32 per cent of the matte grade. Now, it was previously shown that the gold loss is 0.34 per cent of the matte grade, so that, assuming the prills to have the same ratio copper: gold as the matte produced, if the prills are present to the extent of 0.34 per cent of the matte copper this would account for all the gold. The figures above set forth show that this amount of prill copper is usually present, and more than this amount cannot possibly be in the slag without an increase in the gold, which does not occur, so that it is practically certain that all gold in the slag is present as matte prills. This also agrees with Lathe's conclusion.

Or, by another method of calculation, using years' average analysis and finding the gold loss from estimated prill losses:

Taking the average matte assays for two years with slag similar to that at present, and fairly constant running, 1915 and 1919, and working back to the gold loss to compare with the actual slag assay:

1915 Matte 13.4 per cent copper, 5.0 oz. gold (average for year)
Therefore total slag copper (Fig. 4) ..... 0.150 per cent
and dissolved sulphide (Fig. 2) ..... 0.10 per cent
Therefore prill loss is ..... 0.05 per cent copper
Therefore gold in prills = $0.05 \times 5.0/13.4 = 0.0186$ oz.

From operating plot, Fig. 5, the gold loss with matte of 5.0 oz. gold is 0.0172 oz.

1919 Using the relation that prill copper is one-half dissolved-copper (see above
Matte 18.2 per cent copper, 3.6 oz. gold. (Average for year)
Total slag loss, (Fig. 2) ..... 0.175 per cent
Prill loss ..... 0.058 per cent ($0.5 \times 0.175/1.5$)
Therefore dissolved loss= ..... 0.117 per cent copper
Gold in prills = $0.058 \times 3.6/18.2 = 0.0115$ oz.
From operating plot, gold loss is 0.0125 oz.

These calculations, if taken backward, would give methods of estimating prills from slag gold content, as used by Lathe. As can be seen, using any of the relations found to hold, all of the gold can be accounted for as prills, well within the error of prill determination, and it is almost certain that all gold is in this form, the constant proportion of gold in the slag representing the law of averages. However, when the slag was fused with pyrite, only about 40 per cent of the gold was apparently taken out of the slag, but 85 per cent appeared in the matte produced (0.12 oz. See Table I). As the matte figure will be practically unaffected by assay blanks, minute salting in sampling, or other minor factors, this will probably be more accurate than the slag figure. In the second series of fusions with converter slag added, the final slag still had 0.009 oz. gold, despite the fact that the matte button now had 0.77 oz. This constant loss does not denote any form of solubility in slag or prill salting, and can, I think, be neglected in favor of the result arrived at by calculation, although if more accurate work were possible and justified, I think that mere settling of prills would reduce the gold in the slag to practically nothing.

This work was undertaken to obtain as much information as possible before changing to a much higher-grade matte with a somewhat different slag. Two methods of estimating slag loss are therefore at present open:

1. Extrapolation of operating plot previously found, Fig. 4, although this method will certainly give too high a value. The losses by this method should be:

With 40 per cent matte, 0.58 per cent copper in slag
With 50 per cent matte, 1.01 per cent copper in slag
With 60 per cent matte, 1.64 per cent copper in slag

These values are much too high, and may be neglected.

2. Using fusions on the present slag as a basis, and correcting the result for different slags, this method should be comparatively exact if sufficient data were available, but as it is not known what the slag will be, and the correction factors to be applied are mere approximations, it can only be an estimate of what would actually be true.

The slag is expected to be low in lime and silica, and high in iron, say 35 per cent SiO_2, 26 per cent Fe, and 12 per cent CaO (the same as at present).

As near as can be estimated, the losses in the slag will be as follows:

Making 40 per cent matte, the slag will carry 0.25 per cent Cu as dissolved sulphide, Fig. 2. Prill loss should be 0.135 per cent (0.34 per cent × matte grade). As slag is 6 per cent higher in Fe, necessary correction is

$$6 \times (13.5/70{,}000) \times 40 = 0.046 \text{ per cent}$$

(13.5/70,000 times matte grade is the constant found for Fe).

As slag is 7 per cent lower in SiO_2, correction will be

$$7 \times 0.0003 \times 40 = .084 \text{ per cent}$$

(In generalization of operating data, slag was found to increase 0.0003 × matte Cu per 1 per cent SiO_2 decrease).

Therefore total slag loss (0.25 + 0.135 + 0.084 + 0.046) = 0.515 per cent Cu.

Similarly if making 50 per cent matte,

Dissolved sulphide	0.30
Prills	0.17
Correction for Fe	0.055
Correction for SiO_2	0.105
	0.63 per cent Cu

If making 60 per cent matte,

Dissolved sulphide	0.35
Prills	0.205
Correction for Fe	0.069
Correction for SiO_2	0.126
	0.75 per cent Cu

These losses appear to be reasonable; they are a little higher than other smelters experience in making the same grade of matte, as this slag is one generally considered unfavorable for blast-furnace smelting. The results of actual operation will be looked for with interest, so that comparison may be made with these figures.

The following is a summary of this work:

1. Generalization of operating data, showing regular relation between matte grade and slag loss:

Copper loss = (copper in matte) 3 ÷ 140,000 + 0.135 per cent.
Gold loss = gold in matte x 0.34/100

2. Use of silver-nitrate solution to dissolve prills was tested, and found to dissolve no other copper on chilled samples.

3. Methods of analysis for copper silicate tested, and best method found to be decomposition of slag with sulphur dioxide, hydrofluoric, and pyrogallic acids.

4. The copper in converter slag was shown to be largely matte prills, with considerable copper silicate and some copper sulphide dissolved in the slag, the matte prills being held in permanent suspension by magnetite crystals.

5. Blast-furnace slag fused with matte under neutral conditions—i.e., where only slag loss is dissolved sulphide, and plot obtained showing relations between this loss and matte grade.

6. Slag, containing converter slag, fused with matte, showing reduction of magnetite and copper silicate to nearly normal, and also slag fused with copper oxide and then pyrite, and reduced to normal.

7. Copper silicate in average Trail slag found to be about 0.01 or 0.02 per cent copper, and prills, 0.03 to 0.04 per cent, so that dissolved copper sulphide must be present to the extent of 0.09 per cent copper, which checks with fusion of this slag over matte in a neutral atmosphere.

8. Slag loss to be expected on high-grade run was estimated at:

Matte	40	50	60 per cent copper
Slag	0.515	0.63	0.75 per cent copper

I wish to express my appreciation of the courtesy of the Consolidated Mining & Smelting Co., Trail, B. C., for permission to publish this work, and also to thank Mr. F. Lee, research chemist, C. M. & S. Co., for his help and suggestions. The conclusions reached in this paper are my own, and do not necessarily agree with those of the smelter authorities.[1]

South African Mining Industry Improving

The tone of business generally in South Africa shows slight improvement, says *Commerce Reports*, though the situation is not an optimistic one. Mine buying is inactive, and it would appear that stocks on hand in the mines at the beginning of the year were apparently far greater than the trade realized. Business on the Rand is restricted, the money coming into circulation being largely used in liquidating obligations incurred during the strike period, and new purchases are reduced to a minimum.

The mining industry board, appointed to effect a means of settlement of labor troubles such as occurred on the Rand last March, has reported a conciliation scheme which has met with a good reception in financial, industrial, and labor circles, the general feeling being that it will lead to better conditions. Premier Smuts has declared the gold-mining industry of the Transvaal to be "in better condition than it has been for many years." Efficiency of the workers, both white and native, has been increased, and working costs and the costs of mining stores have been reduced.

The production of Transvaal gold for September, a thirty-day month, was 747,089 fine ounces, but 5,401 oz. less than August, the banner month since 1917. Taking £4 12s. 6d. as the value of gold per ounce, the total value of September's output, including the gold premium, was £3,456,286. The number of natives employed in the gold mines at the end of September was 147,565, compared with 175,054 for August. Despite the recent labor settlement and the lower working costs, the Knight Central gold mines, of the Central Rand group, which have been operating without loss, will cease operations on Jan. 31, 1923.

Diamond mining has shown increased activity, owing to the demand from America, India, and the East. The Southwest diamond mines have resumed operations, but not the De Beers mines. Since Oct. 1 the Koffiefontein diamond mines, in the Orange Free State, have worked six days a week instead of five. The increasing sale of diamonds has resulted in the opening of a few small mines which have heretofore been closed. It is anticipated that the large diamond mines which have been shut down will resume operations on a small scale in 1923.

Guatemala Has Valuable Mineral Resources

Minerals of value are found in practically every part of Guatemala, except on the coastal plains, according to a report from the American Consul. The country has been prospected only to a limited degree, but evidences of silver, lead, copper, and zinc are said to be found quite generally. There is an extensive chrome deposit of high grade, and manganese, antimony, mica, and placer gold also exist.

[1]Part I of this article, page 1026, fourteenth line from the bottom, should read: "Dissolved 0.035 per cent Cu."

CONSULTATION

No Standard Specifications for Feldspar Among Producers and Consumers

"I am interested in a Canadian feldspar prospect, but am utterly ignorant of feldspar marketing. In your issue of Oct. 7 I notice that you quote Canadian feldspar at $20, f.o.b. cars at mill. As this is apparently high-grade feldspar, can you give me some idea as to what the specifications are upon it, particularly as to the iron limit; also whether the material is lump just as broken or whether it is ground, and, if so, how fine, or whether metallic iron introduced in grinding has been removed?

"I realize that I may be asking for a great deal more information than you have at hand, but as my efforts to obtain these data from interested parties have been ineffectual I must appeal to you for whatever you may be in a position to give me."

Investigations lead us to believe that no definite standard specifications for feldspar, crude and ground, exist in the United States. Producers and consumers may have agreements that serve in lieu of standard requirements, but they are a matter of individual negotiation rather than universal trade recognition. Therefore, any remarks we may make are only general in character and will not apply to all the producers or consumers in the country.

No. 1 feldspar is usually practically pure material. However, much of the No. 1 feldspar sold as such does not come up to this specification, as most of the readily accessible high-grade feldspar deposits of the United States are exhausted. It is sold in lumps of no particular size. The ceramic industry, which is the most important consuming channel of feldspar, commonly demands No. 2 grades, which are pure enough for its uses. No. 2 feldspar commonly contains a mixture of 70 to 75 per cent feldspar and 30 to 25 per cent quartz. Some manufacturers insist on having the feldspar they purchase correspond with that specification. The bulk of it probably follows this classification rather closely. Incidentally, the ratio of these two minerals as given is roughly found in graphic granite, also called "schriftgranit" in German literature.

Much feldspar is, however, placed on the market in which the ratio of feldspar to quartz is 3 to 2, or even 1 to 1. Although No. 3 feldspar is rarely sold as such, this class of material would be more prevalent in the trade were a stricter insistence on specifications to exist. Many tons of feldspar at the present time sold as No. 2 really belongs to the No. 3 class. Feldspar containing more than 30 per cent of quartz may be considered a No. 3 material.

Some commercial feldspar does not exceed 5 per cent in its content of potash and soda. Inasmuch as the potash content is the most valuable constituent of feldspar, it would seem to be logical to make a settlement on the basis of potash content, but no evidence is at hand that this is being done at the present time. Consumers are averse to receiving shipments of feldspar which contain markedly great variations in potash content.

Fineness of grinding seems to be optional among consumers. They generally demand a product of which 94½ per cent will pass through a 200-mesh screen and only $\frac{5}{16}$ of 1 per cent will be retained on an 85-mesh screen. The total residue on the 325-mesh screen is not to exceed 25 per cent.

Iron is the most objectional impurity in feldspar, and consumers are insistent on having only negligible amounts of iron oxide or metallic iron present, as its presence discolors the pottery made from it. For this reason producers are generally careful to see that their shipments are free from contamination by the overburden of the deposit.

In grinding feldspar, granite buhrstones are still used by some grinding mills. They eliminate the possibility of introducing iron particles into the ground product, a possibility that exists when gyratory or jaw crushers are used for the same purpose. Apparatus to remove the iron particles has been devised, using electromagnets, but is only partly successful in treating the fine material.

The Tallest Stack in the World

It would appear from the following letter that the superlative "tallest" should be applied to the Tacoma stack of the American Smelting & Refining Co., rather than to the Anaconda, although when actual capacity is considered, the Anaconda is the premier chimney:

"I note in the *Journal-Press* of Aug. 19, and again under date of Nov. 18, that the Anaconda stack is called the "highest stack in the world." I think you have been misinformed as to the height of the Anaconda stack. I have seen the drawings of the Anaconda stack, and the 585 ft. of so-called height is from the *base* of the *foundation* to the top of the stack. The shaft or brick part of the Anaconda stack is only 555 ft. high. This is the only effective part of the stack, and it has always been customary with our company's plants to designate the height of a stack as the height of the hollow part of the stack. You can readily see that two stacks of the same height, but one built on solid rock and the other on clay, would have very different heights of foundations. Moreover, a metallurgist is only interested in the hollow shaft of the stack.

"The Tacoma plant of the American Smelting & Refining Co. has a stack with the brick or hollow part 572 ft. 10 in. high *above* the *top* of the *foundation*. The foundation is 30 ft. in height, which would make a stack 602 ft. 10 in. high if designated in the manner of the Anaconda stack.

"Both the Anaconda and Tacoma stacks were built by the Custodis company, and I think this stack company will verify my statements.

"If the question were which were the *largest* stack in the world, I have no doubt that the Anaconda stack would be placed at the top of the list, as it is 60 ft. in diameter at the top. N. L. STEWART.

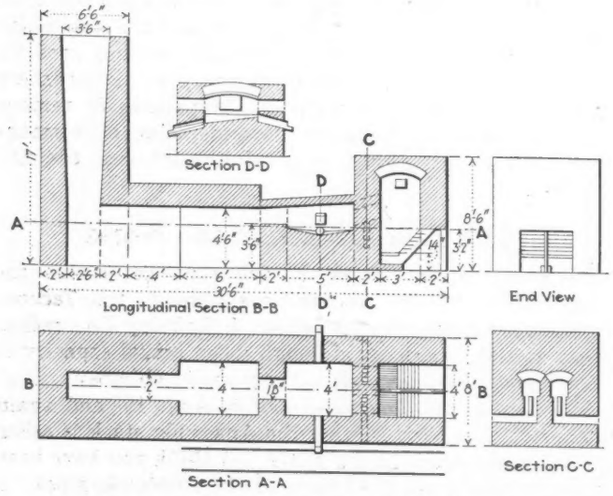
East Helena, Mont.

USEFUL OPERATING IDEAS

A Wood-burning Furnace for Smelting Cyanide Precipitate

BY M. B. EVANS
Former Manager, Grecia Mines Co., Limay, Nicaragua

Metallurgists will undoubtedly be interested in a successful wood-fired furnace for the smelting of cyanide precipitate. For a silver mine situated far from the railroad the freighting of oil for smelting is a serious item, and it is evident that the use of local cord wood at $2 per ton must effect a material saving. If, in addition, everything that goes into the construction of the furnace



Butters wood-burning smelting furnace

can be obtained locally or from the scrap heap, a still further economy is effected. Charles Butters designed such a furnace for the Grecia mine, in Nicaragua, and the saving in fuel alone almost paid for it in nine months.

The furnace is of the reverberatory type, with the customary dust chamber but with a distinctive firebox. In fact, the firebox is the key to success. As seen from the drawings, the fuel is supported almost entirely by the step grate, and the weight of the superincumbent wood does not fall directly on the burning and broken charcoal. As a result, there is a deep but open bed of coals, and the draft is regulated by the amount of ash that is allowed to bank up on the steps of the grate.

Practically speaking, a producer gas is secured, and as the firebox is quite large the rate of firing is so slow that there is no noticeable effect on grates or lining from high temperature. The wood is consumed to a powdery ash, with no clinker. The gas passes through ports to the smelting chamber, mixing with auxiliary air while in the ports, and giving an intense flame well out into the dust chamber. The hearth in the furnace constructed is 4 ft. wide by 5 ft. long, but could certainly well be 8 ft. long and probably 5 ft. wide. There has been no dust, but a glaze forms on the walls of the dust chamber worth $100 per ton.

Smelting takes only one-quarter as long as with an oil-fired tilting furnace of No. 400 crucible size, and the work is incalculably easier and cooler for the men. Comparative costs are given herewith for the last six months with the tilting furnace and for the first six with the reverberatory. It should be noted, however, that the comparison is not quite fair to the new furnace, for the bullion output was smaller in the second period.

COMPARATIVE COSTS OF MELTING, BUTTERS WOOD-BURNING FURNACE VS. OIL-BURNING TILTING FURNACE

Periods Covered

	Tons Milled	Ounces of Bullion
Tilting furnace, February to August, 1921, inclusive	10,745	217,673
Butters furnace, September, 1921, to March, 1922, inclusive	7,978	145,248

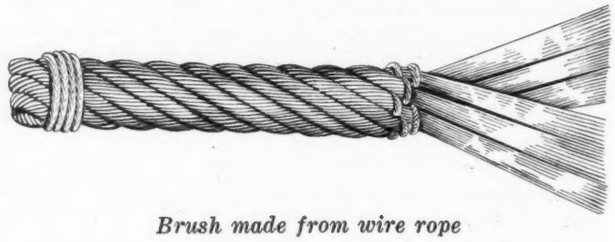
	Per Ton of Ore Milled		Per Ounce of Bullion		Totals	
	Tilting Furnace	Butters Furnace	Tilting Furnace	Butters Furnace	Tilting Furnace	Butters Furnace
Payroll	$0.06120	$0.05749	$0.003021	$0.003157	$657.57	$458.65
Flux	0.07547	0.07174	0.003725	0.003940	810.92	572.34
Fuel	0.16228	0.02257	0.008011	0.001239	1,743.80	180.00
Crucibles	0.06534	.....	0.003225	.....	702.09	.....
Totals					$3,914.38	$1,210.99
Average	$0.36429	$0.15180	$0.017982	$0.008336		
Savings over tilting furnace, per cent	58.33		53.64			
Cost of Butters furnace						$1,373.51

During this seven months the new furnace has more than paid for itself.

The materials used in the construction of the furnace were: worn-out tube-mill liners and similar scrap for grates and doors; local refractory clay made into bricks, for the firebox and smelting zone; and trachyte laid in lime mortar but plastered inside with clay, for the dust chamber and stack. Although local firebrick was used for the hearth, walls, and arch of the smelting chamber, it would undoubtedly be far better to make a monolithic hearth and wall lining of special refractory material and to use imported brick in the arch. On the other hand, the firebox, which was carefully made of local firebrick, could just as well have been made of rock.

Wire Brush for Cleaning Bedrock

In placering, a wire brush is often needed for rough work like that on boulders and bedrock. An inexpensive one which will answer the purpose can be made from common wire cable. A piece 8 or 10 in. long of ½ in.



Brush made from wire rope

to ¾ in. steel cable makes a fairly good brush. By winding some soft wire at the upper end and winding another wire between each strand the brush will keep its shape.

Improved Flotation Machine

BY W. I. NELSON

The flotation equipment of the Engels Copper Mining Co. consists of two Minerals Separation machines and Callow cells for the cleaning of froth. Owing to the cost of freight on concentrate from Engels, Calif., to Garfield, Utah, it is necessary that the concentrate be made as clean as possible without appreciably reducing the amount of copper recovered. The desired grade of concentrate for heads containing 2.25 per cent copper has been found to be between 28 and 30 per cent copper. A further increase in copper content results in a corresponding decrease in recovery.

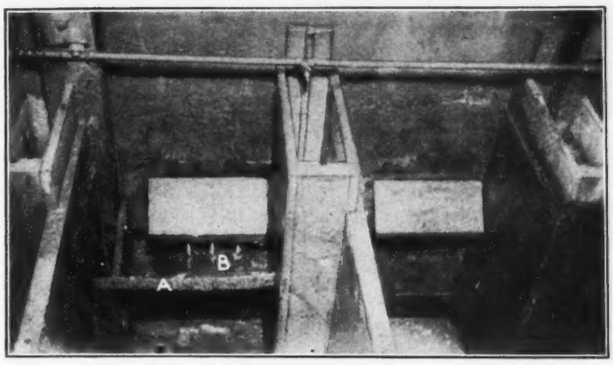


Fig. 1—Cell No. 1 (left) and cell No. 2 of Standard Minerals Separation machine. A. Screen baffle. B. Three vertical baffles.

An arrangement of baffles was added to the M. S. machines which allowed a concentrate to be made assaying 2 per cent higher in copper than formerly, and still giving the same recovery. The baffle arrangement consists of three vertical plates equally spaced in the opening from the mixing chamber to the spitzkasten, and a horizontal board 6 in. below the opening and 10 in. wide extends across the spitzkasten. On the edge of and extending the length of the board is a 4-mesh screen 12 in. high curving from 45 deg. at the board to 60 deg. from horizontal at the top.

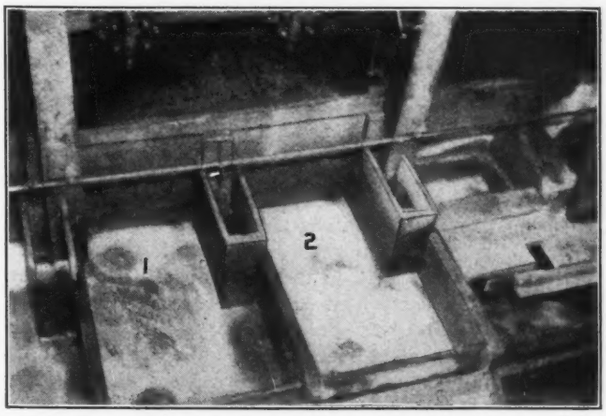


Fig. 2—Cell No. 1 and cell No. 2 under operation, showing nature of surface currents.

Cell No. 2 in Fig. 1 shows the standard Minerals Separation construction in the spitzkasten. Cell No. 1 shows the baffle arrangements added. Fig. 2 shows the nature of the surface currents when operating. In cell No. 2, the froth rises to the surface near the overflow edge of the spitzkasten, and the greater part is swept over before included gangue has had a chance to drop free. A strong eddy at the surface of the pulp tends to carry part of the froth to the back end of the spitzkasten, with resultant losses, as the froth breaks down in the counter-current.

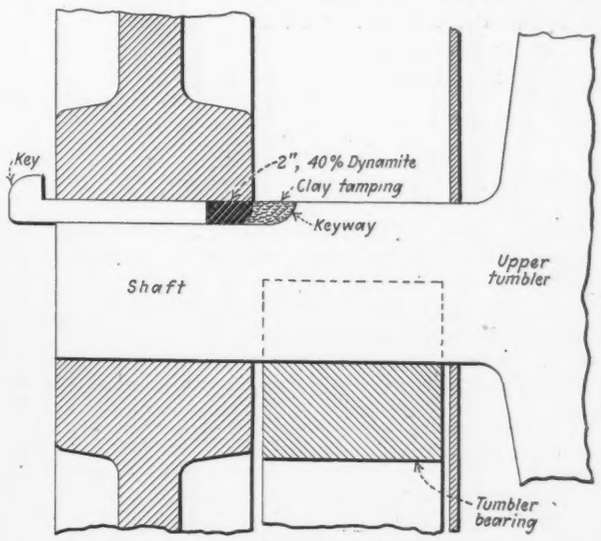
In cell No. 1, the froth rises in the back end of the spitzkasten and flows uniformly in the same direction as the surface flow of pulp toward the overflow lip. Owing to the action of the baffles and screen, the velocity of flow of both froth and pulp is lower in cell No. 1 than in cell No. 2, which gives more time for gangue to settle out of the froth.

The horizontal board and screen deflects the flow so that all of the bubbles rise to the surface in cell No. 1; whereas in cell No. 2 the strong downward current carries some froth to the bottom of the spitzkasten, where it is drawn through to the next cell, the part caught in the flow through the weir box being clearly visible at the overflow. This obviously results in a higher recovery per cell with No. 1 arrangement.

Removing Keys from Upper Tumbler Shafts

BY A. W. ALLEN

Massive keys are used to secure the bull-wheel gear to the upper tumbler shaft of a gold dredge and their removal frequently entails an embarrassing delay. An experienced dredge operator gave the following description of a method which he is successfully using: The upper cap of the tumbler bearing is first removed after turning the shaft so that the key is uppermost. This exposes the end of the keyway. A piece of dynamite (40 per cent) two inches in length is cut off from a $\frac{7}{8}$-in. stick and placed in the keyway, together with a cap, which is embedded in the dynamite, and a short length of fuse. Soft clay tamping is worked down into the end of the keyway and the charge, after appropriate warning, ignited. The result is a sharp blow upon the end of the key. If the first charge is insufficient to start the key, a second charge of dynamite, 3 in. in length is used. Successive charges are used until the key is started. Four keys have been blasted out in four hours thus.



Method of inserting dynamite in keyway

The method described is of general application where keyways are "getatable." Care should be used to start with small quantities of dynamite beginning with $\frac{3}{4}$ in. and increase by one-half inch for each successive shot.

THE PETROLEUM INDUSTRY

Standardization in the Oil Industry from the Engineer's Point of View*

BY A. B. STEEN
Chief Engineer, the Texas Company

It has been suggested that the American Petroleum Institute should have a committee permanently and actually engaged in bringing together its members to adopt standards, and that such committee should be constantly in touch and in co-operation with the American Engineering Standards Committee and the Bureau of Simplified Practice and with related organizations, so that the standards along the lines hereinafter recommended, as well as in other fields not here touched upon, may be worked out and formally adopted.

In order to initiate something in the way of standardization, the industry may well take certain features of rotary drilling equipment that can easily be standardized. In the first place, I think that there should be but two sizes of all rotary drilling equipment, which may be designated as light and heavy respectively, and that standard dimensions sufficient to confer interchangeability should be adopted for the light and heavy form of each element:

Crown Blocks.—Crown blocks of all makes should be of the same length and width of base plate, so that they will all fit a standard size of water table, which then could be the same on all derricks. Structural members should be designed to carry a given load with the same factor of safety. Sheaves can be standardized as to diameter and size of groove, diameter and length of hub, and diameter and length of shaft. With regard to bearings, their design is important in several particulars and these should form a part of the adopted standard:

1. While there are crown blocks equipped to properly lubricate bearings, there are those having only a hole in the cap through which oil is occasionally applied. Adequate equipment, with oil reservoir, for lubricating bearings should be provided.
2. The bearing cap should be hinged onto the bearing or otherwise secured to it so that when necessary to examine bearing or remove shaft the cap will not be detached from its bearing. This is a precaution of safety to those on the derrick below. It has been a pernicious practice in some fields to throw away loose bearing caps to avoid such danger, but this leaves the bearing and shaft journal without protection against dust and rain, which makes proper lubrication impossible.
3. The bearing caps provided with a fastening which can be loosened and tightened without use of a wrench, for safety's sake.
4. The bearing should be closed around the end of the shaft to keep out dirt, especially in transportation.
5. Suitable guards provided in connection with each of the sheaves of the crown block to prevent rope jumping off the sheaves when a break occurs in any of the elements carried by the traveling block.

Traveling Blocks.—The traveling block should have sheaves of the same standard size as the crown block, so that but one size of sheave need be kept in stock for both. A standard hub bushing will then suffice to adapt the sheave to the center pin of the traveling block.

In connection with the sheaves, I believe that those now in general use are too small. It is well understood in professional circles that the larger the diameter of sheaves over which wire ropes have to pass, the longer the life of the rope. The diameter of sheaves should therefore be as large as practicable. The Texas Company has adopted a diameter of 26 in. at bottom of groove as a standard.

It may be of interest to give results of some tests of $\frac{7}{8}$-in. 6 x 19 wire ropes run over 26-in. sheaves. A testing machine was made up of five sheaves, one of which was carried on a lever weighted to impose a load of 7,000 lb. on the rope. The rope was strung around the sheaves and the ends joined to a crosshead. This crosshead was given a reciprocating movement actuated by a crank operated at about 100 revolutions per minute. A number of ropes were tested with the following results; some of them tested to destruction, but in most cases the test was discontinued when a few of the strands parted:

Hours Run		Revolutions
Hours	Minutes	
36	41½	215,064
18	33	106,440
16	40	99,998
18	07	113,700
19	35	118,383
17	30	100,966
18	37½	106,429
19	23½	110,681
20	55½	114,536
18	38	110,067
21	25	120,362
15	55	95,102
17	49	106,796
18	36	116,352
21	37	122,559

The traveling block should be, so far as possible, free from angular projections likely to catch on finger-board and forble-board, and to this end nuts and bolt heads should have rounded outlines and the edges of plates should be rounded or beveled.

Another important feature of the traveling block is the standardization of the lubricating system. Some traveling blocks are made for lubricating with oil, others with grease, the result of which is that it is left to the man in the field to decide which to use. Where the wrong lubricant is used the block often runs dry, and burned out shafts and bushings are the result. There are alternative methods of lubricating traveling block bearing in use. Some makers use a design which carries the lubricant in the sheaves; in others it is conveyed through the center pin. By lubricating through the pin a special lubricating chamber would become unnecessary; then sheaves could be interchangeable with those of the crown block.

Elevators.—Elevators should be provided with hardened steel insert plates to prevent wear of the elevator where collar bears on the same, or if wear does occur, these plates can be readily renewed, and when slight wear does occur they should be renewed. The reason for this is that when the elevator wears to any great

*Excerpted from a paper presented at the annual meeting of the American Petroleum Institute, St. Louis, Mo., Dec. 6-8.

extent it presents a concave surface to the collar, which, in extreme cases of wear, tends to burst the elevator and compress or distort the end of the collar.

Swivels.—A standard hose nozzle connection for swivels should be adopted, and a standard thread for swivel stems. Recesses for ball- or roller-bearing races could be of the same diameters and depth.

Rotaries.—The parts mentioned can be standardized in all particulars as seen from the standpoint of the engineer representing the consumer. The rotary is undergoing changes of design which renders standardization difficult. Some features of design would make a better, more durable and less noisy rotary; machine-cut bevel gears, with pinion running in bath of oil; rollers ground all the same size as near as practicable; main gears, pinion and rollers surrounded by water and dirt-tight hood or housing; the pinion shaft driven by a friction clutch which would eliminate shock and consequent breakage which comes from throwing in a positive action clutch while in rapid motion. The rotary base, instead of being made flat, could be made in box form, or otherwise, in order to give greater stiffness.

Sprockets or gears loosely fitted to shafts, to facilitate removal or replacement, should have two keys, preferably of the Kennedy type. The single key, under stresses in alternate directions, has a tendency to turn over and quickly become loose. With two keys of the type mentioned, stress is in one direction only on either key, and consequently they remain tight.

Draw Works.—Draw works could be standardized as to diameter of drum, drum shaft, diameter and width of base, diameter and length of line shaft, bearings, keys, etc., but before standardizing more thought should be given to the construction and use of a hoisting drum free from the destructive effects on the cable of the present small one. A small drum with numerous windings has the following deficiencies:

1. The hub of the drum is too small, so that cable forms many successive turns upon a radius too small for good practice.
2. The windings are not laid up evenly or, to use the field phrase, "do not spool correctly," leaving irregular spaces between them.
3. At the end of any winding or lap there is left a wedge shaped crevice into which the cable is jammed.

Much thought has been given this detail of the equipment, but there has been nothing, so far as I know, suggested or worked out, that is practical and which gives promise of improvement except a drum large enough to take the necessary length of rope in one layer or winding. A large drum would, of course, require a large brake, and, if of the prevailing type, would be too large to be handled expeditiously, but if a differential brake could not be made to work satisfactorily then a steam hydraulic brake operated by a floating lever could easily be adopted.

Friction clutches should be provided instead of the present type of positive clutch. The positive clutch is usually thrown in while the engine is in motion, which causes destructive shocks to the whole equipment, and if the corners of the jaws are worn, sometimes causes injury to leg or knee of operator by not engaging properly or jumping out when partly engaged. How many of us here would retain a chauffeur who habitually threw in his clutch quickly instead of letting it in gently, yet we ask a driller to follow this barbarous practice eight to ten hours a day.

Engines.—Engines have, in a way, been standardized for a great many years; in fact, we are now using engines designed fifty years ago, and while they are light, easily moved from one location to another and set up, and give very little trouble in operation, it does seem as though we should have the lesign changed in so far that all moving parts are entirely inclosed in order to keep dirt away from wearing surfaces and permit the use of an up-to-date lubricating system.

We still have as regular equipment on some engines the old displacement lubricator—this lubricator, which, because of its erratic operation, is usually consigned to the junk pile by the operator and a joint of 3-in. or 4-in. pipe substituted. Force-feed oilers have been tried out for lubricating steam cylinders and proven entirely satisfactory to the operator.

Pumps.—It is gratifying to note that some pump manufacturers are paying more attention to lubricating the pins, rock shafts, and rollers. However, nothing is provided for lubricating steam cylinders. A force-feed oiler, a duplicate of that used on the steam engine, should be a part of standard pump equipment.

Boilers.—To meet the requirements of some states and permit the transfer of boilers from one state having no code to others that have, I would suggest the adoption of the A.S.M.E. code, and that boilers be designed for 150 lb. pressure. Most of the boilers in the fields are designed for a maximum pressure of 125 lb., but are often worked under a pressure of 140 lb., this pressure being desired not only to increase the power of the engine but to provide a greater range through which the engine can be operated at high speed.

Boiler horsepower is an arbitrary term and means nothing when the work done by the steam is considered; however, it is a convenient one and in universal use in the oil fields. To give the term some value, I would suggest that a definite number of square feet of heating surface per horsepower be adopted. We now have boilers whose rated horsepower is based on anywhere from 8 to 13 sq.ft.

Materials.—"Material" is the subject of other papers at this meeting, but I should like to mention cast iron, particularly that used in steam cylinders. Judging from the appearance of some cylinders after they have been in use for a short time I think that some manufacturers use an iron that is too soft, as they show evidence of rapid wear. Cast iron, if too soft, will not, without too much care and attention, acquire the hard glazed surface so desirable in steam cylinders. So I think the grade of iron to be used in steam cylinders a proper subject for standardization.

Preparing to Drill for Petroleum in Cold Bay District, Alaska

The Cold Bay district, on the Alaskan Peninsula, adjacent to Seward, is the center of vigorous preparations for prospecting for petroleum. Two large companies, the Standard Oil Co. and the Associated Co., have landed several boatloads of complete camp and drilling equipment, and drilling will begin early in the winter. Headquarters have been established at Kanatak, a small village which will be used as a seaport and supply point. The two companies are co-operating in building a road from Kanatak to the drilling sites. Most of the equipment has been landed and is awaiting only the completion of the road, when it will be moved inland and assembled. The country for several miles about has been covered by locators.

New Books

Optical Mineralogy

Elements of Optical Mineralogy. An Introduction to Microscopic Petrography. By N. H. Winchell and A. N. Winchell. Second Edition, Part I, "Principles and Methods." John Wiley & Sons, Inc., New York. $3.50.

Since the publication of the first edition in 1908, many important advances in optical mineralogy have been made, among which are the methods developed for the study of mineral powders and fragments, and small crystals immersed in liquids. In this edition the authors have endeavored to present not only the material necessary for the study of minerals occurring in thin sections but also in powders and fragments and involving immersion in liquids. Much of the text has been used for several years in the Extension Division of the University of Wisconsin.

The fundamentals of crystallography, as applied to the microscopic study of minerals, are discussed in two chapters. The physical and chemical characters are then taken up, followed by chapters on the Elementary Conceptions of Optics, Optical Properties of Isotropic Minerals, Microscopes, Preparation of Material for Microscopic Study, and the Nicol Prism. The optical properties of isotropic, uniaxial, and biaxial minerals are then treated in detail.

The book is well written, the style being clear and concise. The illustrations are numerous and well chosen. The directions for laboratory work found at the end of many of the chapters form an important feature of the book. The text should serve as an excellent introduction to the microscopic study of minerals.

EDWARD H. KRAUS.

A Manual of Belt Conveying

Belt Conveyors and Belt Elevators. By Frederick V. Hetzel. John Wiley & Sons, Inc., New York. $5.

Not infrequently the engineer—in matters of plant design—failing an exact knowledge of some particular part of the work, seeks recourse to textbooks on the subject. These may or may not give him the desired information; he may consult the technical periodicals, and in every case the thoroughness of his investigation is largely dependent on the knowledge required to do the job. We believe that every engineer has, at some time or other, experienced a dissatisfaction at the lack of information contained in certain books—obviously this must be so or the publishers of technical works would lead a precarious existence. But occasionally there comes to our notice a book which contains more than technical platitudes, formulas, and tables; and we decide that our "five-foot shelf" can be enlarged sufficiently to make room for the new chum. Mr. Hetzel, in his book, "Belt Conveyors and Belt Elevators," has made a real contribution to the subject, and has written, as he intended, "a practical book." The field of application for this type of equipment is a large one, and the data presented cover, in a thorough manner, the general principles underlying the design and use of conveying and elevating machinery. The author does not regard it as sufficient to consider merely types of equipment, but has pointed out the "when," "why," and "how," constituting therein a book that represents real value to one who has to do with belt transportation. D. E. A. CHARLTON.

Canadian Talc and Soapstone

Talc and Soapstone in Canada. By Hugh S. Spense, Canadian Department of Mines, Ottawa. Free.

The Mines Branch of the Department of Mines at Ottawa has produced a number of notable works on non-metallic minerals, the latest of which is a bulletin on talc and soapstone. The introductory chapter includes the results of thirty analyses, chiefly of Canadian talcs, and gives the general distribution of deposits. The most important deposits in the country are at Madoc and Eldorado, in Hastings County. The largest mine is the Henderson, opened in 1906. It produces a high grade of talc, which is marketed both in crude and ground form. This and two other mines in the same vicinity have produced practically all the talc mined in Canada in the last twenty years. Other deposits occur in the eastern townships of Quebec, northern Ontario, British Columbia, and Nova Scotia. Tables of production, imports, exports, and consumption by uses are given. The various deposits and mine equipment are described in detail in Chapter II. Chapter III gives the physical properties and uses of the mineral, together with methods of mining and milling, the latter processes being shown graphically by a series of flow sheets. The final chapter deals with deposits in foreign countries. A bibliography of the subject is added. The bulletin is important, particularly in view of the few published reports on talc now available.

OLIVER BOWLES.

Electrical Handbook—The Electric Power Club (Kirby Building, Cleveland, Ohio) has issued a new edition (the fourteenth) of its handbook, covering substantially all the standardization it has effected in the electric motors, motor pulleys, generators, transformers, electric tools, mining and industrial locomotives, control equipment, power switchboards, and switching equipment manufactured in this country. The handbook contains, also, definitions, symbols, general engineering recommendations, and other information needed by users and purchasers of electric-power apparatus and control equipment. Copies are furnished free to responsible engineers.

Technical Papers

Electrical Shot Firing—Wherever it is feasible to adopt electrical shot firing for either mining or quarry work, this should be done as a safety measure, according to U. S. Bureau of Mines *Reports of Investigations*, Serial No. 2,405, 17 pages, obtainable on request to the Bureau at Washington. The bulletin gives the federal and various state regulations for electrical shot firing.

Alaskan Mining—Bulletin 739-A of the U. S. Geological Survey, Washington, D. C. (50 pages; free) is the first section of the report on the mineral resources of Alaska for 1921, and discusses the Alaskan mining industry for that year. The mining industry was somewhat more prosperous than in 1920, though the total mineral production decreased from $23,000,000 to $17,000,000, chiefly owing to the lower price received for copper.

Western Ore-Treatment Plants—In the Nov. 12, 1921, issue of this journal, attention was called in this department to a list of the ore-treatment plants in the Western States prepared by the U. S. Geological Survey. Additions to the list published include Serial 2,287-I, Colorado; No. 2,287-J, South Dakota; and No. 2,287-K, Texas and Wyoming. Copies may be obtained free on application to the Director, Bureau of Mines, Washington, D. C.

Mesabi Wash Ores—In *Skillings' Mining Review* of Nov. 18 and 25 (Duluth, Minn.; price 10c. each) is an article by A. M. Gow and Alex Gow on "The History and Development of Wash Ores of the Mesabi Iron Range."

Air Lift—"Air Lift for Dewatering Mines" is the title of a three-page illustrated article in the November issue of *Compressed Air Magazine* (11 Broadway, New York City; price, 35c.), which describes the equipment at the Jermyn mine, of the Hudson Coal Co., for the emergency removal of water.

Nickel—The Imperial Mineral Resources Bureau has recently published a 56-page bulletin on nickel during the war period (1913-1919), of a nature similar to the other pamphlets issued by that organization. (Obtainable from H. M. Stationery Office, Imperial House, Kingsway, London, W. C. 2, England. Price 1s. 7½d). The bulletin contains general and statistical information on nickel, with brief reference to the various deposits throughout the world.

Mine Fires—U. S. Bureau of Mines Bulletin 188 (88 pages; free from the Bureau at Washington) is entitled "Lessons from the Granite Mountain Shaft Fire, Butte." The bulletin tells of the rescue work carried on at the time of this famous mine fire in 1917, when more than 100 persons were killed, and conclusions and recommendations based thereon.

SOCIETIES, ADDRESSES, AND REPORTS

Mining Engineers Discuss Marketing

Specialists in Non-Ferrous Metal Markets Address Mining and Metallurgical Society

At a dinner of the Mining and Metallurgical Society of America held at the Harvard Club on Dec. 6, the selling of the most important non-ferrous metals was described authoritatively by persons familiar with their own particular fields. C. M. Weld, chairman of the meeting, first called on Hamilton Brush, sales manager of the American Smelting & Refining Co., to speak on the marketing of copper. Mr. Brush handled the subject so thoroughly that he fired most of the ammunition of the next speaker, Mr. Church, of the Nichols Copper Co., who discussed the same topic. Mr. Brush enlarged on the history of the market and stated that it was highly competitive and lacked a dominant leader. He said the American copper industry was a "fifty-fifty" industry, in that its prosperity was dependent equally upon foreign and domestic sales. The Copper Export Association, according to him, had resulted in securing higher prices for copper in Europe than in the United States, thus reversing the situation that existed prior to the war and prior to the formation of the association, at which time foreign purchasers were so well organized that they were able to obtain lower prices for American copper than could consumers in this country.

Clinton H. Crane, president of the St. Joseph Lead Co., next outlined the marketing of lead, indicating the influence of imports of lead into the United States, a condition that partly accounted for the existence of two markets in the United States, New York and St. Louis. New York received much Mexican and other lead imports, whereas St. Louis was the market for the great middle-western lead field. Mr. Crane said it was the policy of the producers to deal directly with consumers, to sell lead in quantities only large enough to satisfy current requirements of consumers, and to avoid having anything to do with sales that savored of speculation. Mr. Crane made plain that the impurities in commercial grades of lead were highly important in determining the suitability of those grades for certain purposes and that it was desirable to have close contact with the consumers so as to meet their special needs.

George C. Stone, chief metallurgist of the New Jersey Zinc Co., discussed the application of zinc and its statistics rather than actual marketing. He stated that the high price of zinc a few years ago encouraged the use of black, ungalvanized sheets instead of galvanized ones, and that the industry was feeling the effect of this substitution.

The marketing of tin was described by J. H. Lang, of the American Metal Co., who called attention to its speculative character, its many uses, and the fact that the American market slavishly followed the London price gyrations. He made a plea for a broader market in the country, not only in tin but in other metals.

Charles Hardy, of Charles Hardy & Ruperti, in the fifteen minutes at his disposal spoke of the marketing of manganese, chrome, tungsten, and vanadium ores, and indicated the importance of these products to the alloy-steel industry. He believed that the new tariff would be of great benefit to the producers who imported those ores prior to the advance in rates, and of little benefit to domestic producers.

Harris K. Masters, of the Wah Chang Trading Corporation, supplemented Mr. Lang's remarks by describing the Singapore tin market, in which bids of concentrate buyers are collected and a price is set daily from these bids. He maintained that the marketing of antimony was unimportant compared with that of other metals and stated that the metal had sold as low as 3¾c. c.i.f. recently. Only cheap Asiatic labor, he alleged, could produce the antimony at such a price level. He did not think the tariff would aid domestic producers.

Reception and Banquet in Honor of Gelasio Caetani

The American Institute of Mining and Metallurgical Engineers, with the co-operation of the other Founder Societies, is arranging to give a reception and banquet on Jan. 10 in honor of Prince Gelasio Caetani, the newly appointed Italian Ambassador to the United States, who will arrive in this country about Dec. 20.

Prince Caetani is a graduate of the School of Mines, Columbia University, and was for many years identified with the mining industry in the Far West. At the outbreak of the war he gave up his mining interests to return to Italy to join the colors. During the war he became Colonel of Engineers in the Italian army and distinguished himself by some brilliant engineering exploits.

Full particulars of the date and place of the banquet will be given in a later issue of the *Journal-Press*. It is fully expected that there will be a large attendance of engineers. All the engineers of the United States are invited to attend the banquet.

Petroleum Men Convene at St. Louis

Institute's Third Annual Meeting Held at Statler Hotel—Attendance Large —O'Donnell Re-elected President

With a registration of approximately seven hundred delegates on the first two days, the third annual meeting of the American Petroleum Institute, held at St. Louis, Mo., Dec. 6-8, was early assured of success. Thomas A. O'Donnell was re-elected president; R. D. Benton, Henry L. Doherty and J. W. Van Dyke, were elected vice-presidents; H. S. Sinclair, was elected treasurer; R. L. Welch, secretary and counsel; W. R. Boyd, Jr., assistant secretary and counsel; and Lacey Walker, assistant treasurer.

Mr. O'Donnell, in his presidential address, which was delivered on the opening day, discussed conditions in the California oil fields. "Our drilling activity is still continuing," he said. "My personal judgment is that we are nearing the peak of production and, contrary to development in California in the past, I believe there will be a rapid decline when that peak is finally reached. Our California production, as a usual thing, is the most stable production in America. . . ."

A. C. Bedford, chairman of the Standard Oil Co. board, talked on the oil industry, its growth and its relations to the government. W. S. Farish, president of the Humble Oil & Refining Co., in his talk on "Oil in the Southwest and Its Future," commented on the hostility of the general public toward the oil industry in most districts, saying that there had been some judges who seemed to feel that an oil company was entitled to little consideration.

F. E. Kistler, president of the Producers & Refiners Corporation, talked on "My Faith in Wyoming and Montana," describing incidentally the Salt Creek field. "Financing the Oil Business," was the topic of James J. McGraw, president of the Exchange National Bank of Tulsa.

At the annual dinner on the evening of Dec. 6, Col. Robert W. Stewart acted as toastmaster. Judge A. L. Beaty, president of the Texas Company, discussed the future of petroleum, saying that he believed that the petroleum industry had not yet reached its zenith. "But," he said, "broadly speaking, the days of phenomenal profits are past, just as are the days of complete monopoly and the period when the extent of profits was not generally known, or else the business was considered not dependable and permanent. . . ."

The details of the program have previously been announced.

MEN YOU SHOULD KNOW ABOUT

W. H. Shockley, of Palo Alto, Calif., is in New York.

George W. Starr has returned to Grass Valley, Calif.

Edwin E. Chase is at Butte, Mont., on professional business.

E. F. Burchard sailed Dec. 6 from Buenos Aires for the United States.

George C. Klug, of Melbourne, Australia, left New York for San Francisco on Dec. 6.

N. H. Darton has returned to Washington after extended field work in Arizona.

H. S. Denny is making a short visit in New York, and will leave soon for Ontario.

J. C. Scoles, formerly engineer of the Tintic Standard Mining Co. near Eureka, Utah, is in San Francisco.

William G. Mather, president of the Cleveland-Cliffs Iron Co., is expected to return soon from a trip to Japan.

C. H. Brandes is returning to New York the latter part of December after a four months' business trip in Europe.

George D. Wolfe arrived in New York recently from Durango City, Mexico, and expects to remain here until January.

Pope Yeatman and several assistants are making an examination of several of the mines in the Michigan copper district.

Dr. Kuno B. Heberlein will return to New York the latter part of this month after a two months' business trip to England.

H. A. Guess, of New York, managing director of the Federal Mining & Smelting Co., is in Wallace, Idaho.

John G. Kirchen, general manager of the Tonopah Extension Mining Co., has recently visited San Francisco and Los Angeles.

F. L. Ransome and **H. A. C. Jenison**, of the U. S. Geological Survey staff, are at Flagstaff, Ariz. From there they will go to Oatman.

Gibson Berry, superintendent of the Round Mountain mine, at Round Mountain, Nev., is visiting San Francisco and other coast points.

Dr. Henry M. Payne is at Ixtlan del Rio, Nayarit, Mexico, where he is engaged as mining engineer and general manager of the Humboldt Mining Co.

Charles M. Schwab, principal owner of the Tonopah Extension mine, has been in Tonopah to inspect the recent high-grade developments on the 1,880 level.

Alberto Terrones Benitez, correspondent of the *Journal-Press* in Durango City, Mexico, has been appointed general agent for the Secretary of Agriculture and Fomento, with jurisdiction in the State of Durango.

The Phelps Dodge Corporation, Copper Queen branch, has announced the resignation of **Arthur Notman**, mine superintendent of the Copper Queen mine, and for fourteen years associated with the Phelps Dodge mines, effective Dec. 31. He has been in charge of mines at Bisbee since Jan. 1, 1918, when he succeeded Gerald Sherman, who became consulting engineer, with headquarters at Douglas. Mr. Notman has done much mineral survey work in the Morenci district, at Globe and at Bisbee. He leaves Arizona to become associated with James R. Finlay, at New York City, in geological and mine consultation work. Mr. Notman will be succeeded by **Harry Hays**, who has been in the office of P. G. Beckett for two years and in the service of the company since 1909, save for the period of his war service.

Arthur Notman

R. S. Baverstock has returned to Los Angeles from an examination trip in the Ord Mountain and Barstow districts of San Bernardino County, Calif., and expects to leave soon for Culiacan, Sinaloa, Mexico.

Garret Mott, chairman of the board of directors of the Superior & Boston Copper Co., and **J. F. Barry**, of Boston, secretary of the board, have arrived in Globe, Ariz. for a ten days' visit at the company's property and at other mines in the district.

Edel Moldenke, formerly superintendent of the Southern Spar & Mica Co., of Swannanoa, N. C., is now mining engineer for the American Black Marble Corporation, New York, and resident manager of that company's plant at Harrisonburg, Va.

Amos L. Beaty, president, and **R. C. Holmes**, vice-president and general manager of the refining department of the Texas Company, were in Houston, Tex., recently on business. From there they went to north Texas and Arkansas to inspect certain oil fields. Mr. Beaty addressed the convention of the American Petroleum Institute at St. Louis.

C. J. Mott, superintendent for the Oliver Iron Mining Co., at the Trout Lake concentrator, Coleraine, Minn., has tendered his resignation, to be effective Jan. 1, 1923. Mr. Mott has been associated with mining on the Mesabi iron range since 1894. He intends to move to Los Angeles and devote some of his time to development of mineral claims in San Benito County, Calif.

Harry Coffin, who for the last fourteen years has been president of the reorganized Alabama Company and a prominent figure in iron circles in the South, has resigned, to go into business for himself. He is succeeded by **John W. Porter**, formerly vice-president, who has been connected with the company in various capacities for the same length of time.

In recognition of his appointment as chief mine engineer of the Maryland Bureau of Mines, **Dr. J. J. Rutledge** was tendered a dinner in Washington by thirty-two of his friends who have been associated with him in his work with the Bureau of Mines. **Samuel Sanford**, the editor for the Bureau of Mines, acted as toastmaster. Dr. Rutledge secured the Maryland appointment as the result of a competitive examination.

Gordon R. Campbell and **James Fish**, of Calumet, Mich., president and secretary respectively of the Calumet & Arizona Mining Co. and the New Cornelia Copper Co., and **Thomas Hoatson**, of Calumet; **Thomas F. Cole**, of New York; **George A. Newett**, of Ishpeming, Mich.; and **Thomas Collins**, of Princeton, Mass., directors, are inspecting the holdings of the two companies in New Mexico and Arizona.

Mining and metallurgical engineers visiting New York City last week included: **James O. Handy**, of Pittsburgh; **E. H. Ingram**, of Brighton, Mass; **Charles W. Tubby**, of Seattle; **B. L. Miller**, of Bethlehem, Pa.; and **Rex** Townsend, of Washington, D. C.

OBITUARY

Christian Louis Berger, senior member of the firm of C. L. Berger & Sons, died on Nov. 19. He has been for many years an inventor and maker of precise scientific and astronomical instruments.

Carl F. Buck died Dec. 1 at his home in Newark, N. J. He was born June 8, 1871, at Coffeyville, Kan., and in his youth learned the machinist trade, later taking up architectural designing, in which he was actively engaged for twelve years in the cities of St. Louis, Kansas City and Chicago. He had an inclination toward mechanical engineering, and in 1900 he formed a connection with the American Smelting & Refining Co. In his capacity as mechanical engineer and designer, he was closely identified with the design and construction of the company's most important properties, particularly the smelters at Murray and Garfield, Utah, and Hayden, Ariz.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

BUTTE & SUPERIOR has declared a dividend of 50c. per share—the first since 1917. Prosperity in the zinc-mining industry is reflected by the action of the largest producer in Montana.

The Hecla Mining Co., in the Coeur d'Alene of Idaho, will pay an extra dividend of 50c. per share.

The California Rand Silver, Inc., will double the capacity of its 200-ton flotation plant at Randsburg.

The Goldroad mine, in the Oatman district, Arizona, will be reopened by the United States Smelting, Refining and Mining Co.

President Agassiz of the Copper & Brass Research Association notes progress in popularizing his "favorite" metals.

World's silver output in 1922 is estimated at 175,000,000 oz. by London firm of Samuel Montague & Co.

Cable advices state that Broken Hill mines, in Australia, will be reopened.

Lake Superior copper mines will not be handicapped by shortage of coal.

Rumors of the building of a lead smelter at Eureka, Nev., persist.

Park-Utah Distributes $150,000; Total $550,000 Since Last Christmas

"New" Mine Has Made Excellent Record During the Year—Comfort of Employees Considered

The Park-Utah Mining Co., operating in the Park City district in Utah, has posted a dividend of 15c. a share, or $150,000, equal in amount to that for the third quarter, when the rate was increased from 10 to 15c. a share. Dividends for the first and second quarters of the year amounted to $100,000 each. The first dividend by the company was a Christmas dividend paid a year ago, which amounted to $50,000, so that in a little over a year the company, since beginning payments, will have paid $550,000.

In addition to this, considerable new construction, amounting in cost to $205,000, has been done. The Ontario drain tunnel has been entirely electrified and equipped, so that all of the ore mined passes through it to the Daly West shaft, from which it goes directly to the railroad cars. In this way the haul to the railroad at Heber is obviated. At the surface a boarding house for 250 men has been erected and a dining and recreation room, with a hard-wood floor for dancing. A row of modern houses for married men has been built. There i a concrete change room with the most complete ventilating system, and fireproof office building.

Production during ten months ended Oct. 31 has amounted to 34,600 tons of ore, of an average selling value of $35.56 per ton, making total ore sales of $1,230,594. Silver produced amounted to 1,562,841 oz. in the ten months, and in the last three months production has been at the rate of 225,000 oz. monthly.

United States S. R. & M. Co. Has Reopened Goldroad Mine

Work has started at the Goldroad mine of the U. S. Smelting Refining & Mining Co., near Oatman, Ariz., under the direction of D. R. Muir, former manager. Repairs are being made to the 300-ton mill and the mine is to be put in condition for continuous production. The Goldroad mine is on the same range of mountains on which are located the United Eastern, Tom Reed, and Katherine mines. It is four miles from Oatman, and up to the time of its closing, six years ago, it had produced approximately $10,000,000.

World's Silver Output 175,000,000 Oz., Say Samuel Montague & Co.

During the first six months of the year the output of silver in Mexico was 37,000,000 oz., and a fresh annual record is likely, while that of Canada is brought up to 8,500,000 oz. As the United States output is also increasing, Messrs. Samuel Montague & Co., bullion brokers who "set" the price for silver in London each day, state that a world's total of at least 175,000,000 oz. may be expected.

Discovery of Lead Deposits in Spain

By Cable from Reuters to "Engineering and Mining Journal-Press"

Madrid, Dec. 5.—The discovery of a number of large lead deposits in the Province of Ciudad Real, adjoining Jaen and Cordoba, is reported. It will be possible to work these mines when the railway from La Carolina to Puertollana is opened.

Butte & Superior Resumes Dividends—First Since September, 1917

Settlement of Apex and Flotation Litigation and Resumption of Operations Pave Way

After five years of suspended payments, the board of directors of the Butte & Superior Mining Co. on Dec. 8 declared a dividend on the common stock of 50c. per share, payable Dec. 30, to stock of record Dec. 15. The last dividend paid by the company was $1.25 a share, paid on Sept. 29, 1917.

In making the announcement of the dividend, officials of the company said that "while profits for the entire calendar year will be very small, due to the losses and shutdown expense as shown in the quarterly reports for the early part of the year, the increase in production plus the advance in the price of zinc is now permitting the company to show reasonable profits in excess of dividend at the rate declared." Attention is called to the fact that "the cash position of the company is exceedingly strong."

The resumption of dividends calls attention to the notable improvement in both zinc demand and price in the last six months. The ruling quotation is now 7.35c., East St. Louis, compared with 5¾c. in the middle of May, while consumption is about 35 per cent greater than before the war.

This is the first dividend payment by Butte & Superior since September, 1917. Expensive litigation with Senator Clark's neighboring property as to title to orebodies, and with Minerals Separation concerning the right to the use of the froth-flotation process for treating its ores, and post-war slump in zinc prices and demand, explain the long

suspension. Both of the legal controversies have now been settled.

Butte & Superior, owing to the condition of the zinc market, was forced to shut down its property in December, 1920, until Jan. 16 this year. Since then earnings have shown steady improvement, and with settlement of the flotation litigation by compromise early this spring, resumption of dividends became merely a question of time.

Miners are returning, so that Butte & Superior should be in a position to increase its output somewhat. As the cost of producing zinc is about 5½c. a pound, with an output at 25,000 to 30,000 tons of ore a month, and present wage scales, a price around 7½c. for zinc will permit excellent earnings. So far this year the company has averaged about 7,000,000 lb. of zinc per month.

Copper Converting Patent Suit Begins at Wilmington, Del.

The trial of the patent infringement suit brought by the Pearce-Smith Converter Co. against the United Verde Copper Co. began on Monday, Dec. 11, at Wilmington, Del., before U. S. District Judge Hugh M. Morris of the District of Delaware. The patent involved in the suit is the U. S. patent of E. A. Cappelen Smith, No. 943,280, patented Dec. 14, 1909, for "Improvements in Bessemerizing of Copper Matte." This is the so-called heat-control patent of the Pearce-Smith Converter Co. The patent relates to the converting of copper matte in a basic-lined converter and the proportioning of the amount and composition of the flux to the volume of air blast admitted so that at the termination of the blow there will result a thin and fluent slag at a temperature insufficient to substantially attack the lining.

The plaintiff is represented by William H. Davis and Merton W. Sage, Livingstone Gifford, and John F. Neary, all of New York City. The defendant's counsel are: Charles Neave, Maxwell Barus, and Edward L. Blackman, all of New York City.

Hecla, Coeur d'Alene Company, Pays Extra Dividend

The Hecla Mining Co., of Wallace, Idaho, has declared the regular quarterly dividend of 15c. per share and an extra dividend of 35c. per share, making a total disbursement of 50c. per share, payable on Dec. 20 to stockholders of record Dec. 1. The advance in the price of lead during the last few months has increased the earnings of the company to an extent that justified the extra payment, and the dividend date was advanced to the 20th instead of the 28th, the regular date, as a Christmas surprise for stockholders. Hecla is capitalized for 1,000,000 shares, and the disbursement will therefore be $500,000. The company paid $150,000 in each of the preceding quarters, and the coming dividend will bring the total for the year up to $950,000 and the grand total paid by the company to $10,255,000.

Agassiz Notes Expansion in Use of Copper and Brass

Reviews Work of Research Association at Second Annual Meeting

R. L. Aggasiz, president of the Calumet and Hecla Mining Company, who was re-elected president of the Copper and Brass Research Association at the annual meeting held on Dec. 6, expressed satisfaction at the progress made in increasing the use of the metal and alloy during the year.

The directors, at an organization meeting immediately following the annual meeting, elected the following officers: President, R. L. Agassiz; vice-presidents, C. F. Kelley, F. S. Chase, H. J. Rowland, Walter Douglas and U. T. Hungerford; treasurer, Stephen Birch; secretary, G. A. Sloan, and manager, William T. Willis.

Mr. Agassiz said further:

"The research and educational work of the Copper and Brass Research Association has played an important part in the rapid growth of consumption of brass and copper during the last year, for, despite uncertain business conditions, copper consumption in this country is now substantially greater than in pre-war years. Having digested an unprecedented quantity of war-time scrap metal, the industry is now in a strong position.

"The underlying purpose of this whole effort is to develop to the maximum the domestic consumption of the metal. Export trade will always be a large factor, but it will be possible, we believe, to so augment the American use of the metals that the varying industrial pulse of Europe will be much less influential in determining the prosperity of the industry.

"In this connection it is interesting to note that while the 1922 consumption of copper and brass in the building industry in this country was about 150,000,000 pounds (an increase of more than 100,000,000 lb. as compared with 1921), yet the potential market for copper and brass in the building industry is placed at approximately 650,000,000 lb. annually. The constantly growing domestic use of brass, which is only next to the electrical industry as a consumer of copper, is another helpful factor.

"The electrical industry, where the physical properties of copper are indispensable, is in reality only in its infancy. The high cost of fuel, and uncertain and expensive transportation, are responsible for the growing use of electric power generated at central points, distribution over wide areas being possible economically because of copper's high conductivity.

"Our plan is to provide through the instrumentality of the Copper and Brass Research Association a technical and advisory service which may be freely called upon by users of our metals—a service which no one copper or brass producer or manufacturer could reasonably be expected to undertake alone. Already wide use is being made of these facilities. Information has been furnished on the use of copper and brass for almost every conceivable subject, from safety pins to locomotive boiler tubes.

"An important accomplishment has been the fact that many of the more than 2,000 manufacturers who produce articles made of brass or copper have taken advantage of the association's activity to individually advertise their products, thus extending the association's own educational work. The association has found a ready response all over the country to its campaign directed toward eliminating waste in industry and in the home by the use of a non-corrodible metal, a waste the size of which was demonstrated by a survey conducted by the association, showing that rusted metal in homes alone costs home owners more than $600,000,000 annually—about five or six times as much as the fire loss."

Sulphur Miners Want Europe to Use Their Product in Acid Making

Efforts to find new outlets for sulphur will be one of the principal activities of the recently formed Sulphur Export Association, which includes the three large American producers, Texas Gulf Sulphur Co., the Union Sulphur Co., and the Freeport Sulphur Co. Production for some years has been in excess of demand. Rearrangement of agencies to handle export business in Europe will be followed by an intensive campaign to induce European manufacturers of sulphuric acid to use of free sulphur instead of pyrites.

In early days of sulphuric acid manufacture in Europe, practically the entire production was made from burning free sulphur. When the Neapolitan government granted a monopoly for the exportation of sulphur to a French firm and the price of sulphur went up to $70 per ton, pyrites was substituted and it has never since lost its place, despite easily demonstrable advantages of sulphur.

In the United States free sulphur has displaced pyrites and Sicilian brimstone, which formerly composed 95 per cent of the world supply of natural sulphur. United States production comprises 80 per cent of world supply. In 1892 the production was 2,400 tons, while imports were 101,996; Silician production was 411,828 tons, and exports 318,850. By 1908 American production reached 369,444, while imports dwindled to 20,118 tons. In that year Sicily produced 404,297 tons and exported 375,073. United States production reached the peak in 1921, at 1,879,150 tons, and imports were only 50 tons.

United States exports increased from 590 tons in 1900 to 477,450 in 1920. Last year they were 285,762 tons, and the current year's exports are expected to be in excess of 250,000. Sicily in 1921 produced 240,089 tons and exported 105,063.

World stocks are estimated at 3,275,000 tons, of which about three million is in hands of American producers. Production has been brought near the estimated consumption of 1,000,000 tons annually for domestic and foreign use. With co-operation in the industry and price stabilized at $14 to $16 a ton at the principal marketing points, sulphur companies are expecting good profits during the coming year.

California Rand Silver, Inc., Plans to Double Mill Capacity

Ore in Sight to Continue Shipments at Current Rate Through 1923—Litigation Started

The California Rand Silver, Inc., operating at Randsburg, Calif., has increased its mill capacity from 150 to 200 tons per day by the addition of a new crushing unit delivering a finer feed to the ball mill. The grinding, flotation, and settling units will now be doubled, bringing the capacity up to 400 tons per day. The company's annual report states that it has a 'reasonably assured" tonnage of ore, assaying 20 oz. per ton, to supply the mill for 1923, with a "reasonably assured" tonnage of shipping ore—100 oz. per ton—to continue shipments at current rate during 1923. As the rate of shipment is 1,000 tons per month to the smelters, 1923 promises to be a busy year. Some time ago the company announced the discovery of a vein at 600 ft. depth in No. 6 shaft. on the extreme north end of its property. The shaft was sunk over 500 ft. in depth through a cemented granite wash before encountering the schist formation. New and heavier equipment is being installed at No. 6 shaft.

A "semi-commercial" furnace for smelting concentrate at the mine is being erected. Experimental work has resulted in the development of a successful process using trona as a flux. The present installation is preliminary to building a twenty-ton plant which will handle the concentrate from two hundred tons of ore per day.

The Randsburg Silver Mining Co., owning claims north of the new discovery has started two new shafts, and the Fox lease is installing new electrical equipment to continue sinking its shaft from the 700 to the 1,000 level, at which point a crosscut will be extended east toward the new ore zone. The Randsburg Silver Mining Co. started ore shipments on Nov. 1. After six cars had been shipped, the California Rand, Inc., asked the federal courts for an injunction. The first hearing will be held in December. This promises to be an interesting apex suit; the "experts" have been at work for a long time.

Rhodesian Mineral Output

The British South Africa Co. announces the following mineral output from South Rhodesia during October. Comparative figures are given by renters for the preceding month and also for the corresponding month last year:

	October, 1922	September, 1922	October, 1921
Gold, oz.	54,670	55,443	53,424
Silver, oz.	14,433	14,393	13,342
Coal, tons.	47,089	46,070	49,306
Chrome ore, tons.	nil	20,495	102
Copper, tons.	287	288	271
Asbestos, tons.	1,668	1,558	629
Arsenic, tons.	24	17	112
Mica, tons.	7	5	21
Tin, tons.	nil	1	nil
Diamonds, carats	27	46	nil

The number of producers is 177, and the value of the gold produced £255,619, as against £240,846 for September.

Automatic "Stops" Failed to Stop Skip Soon Enough

The skip was smashed and the headframe damaged and two 10-ft. sheaves were broken at "D" shaft of the East Norrie mine on the Gogebic Iron Range, in Michigan, on Dec. 6 by an overwind. The hoist is geared to a 900-hp. motor and is equipped with two automatic stops; the accident emphasizes the need of keeping these in close and accurate adjustment. A new engineer was being trained and when the empty skip was near the collar he inadvertently hoisted it instead of lowering it. The loaded skip on a long rope started the hoist so fast that the automatic stops could not check it before the empty hit the top of the headframe.

Lake Copper Mines Have Plenty of Coal for Winter

November coal shipments into the Michigan copper mining district were heavier than those for any month in the last four years, 200,000 tons being received. Coal stocks are now ample for all purposes during the winter and will carry the mines, mills, and smelters well into the summer. The situation was threatening in September and a shortage of fuel was anticipated.

Broken Hill Mines Will Be Reopened

By Cable from Reuters to "Engineering and Mining Journal-Press"

Sydney, Dec. 5.—The mine owners have informed the Minister of Mines that the Broken Hill mines will be reopened as soon as the necessary legislation has been passed through Parliament.

West Australian Gold Output

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, Dec. 9.—The production of gold in Western Australia during November totaled 46,554 ounces.

Sand or Silica?

The question, When is sand not sand? has been put up to the customs division of the Treasury Department in connection with imports of silica. Imports, for use in pigments and in the manufacture of glass are being held awaiting a ruling.

The question has arisen because of an apparent conflict in the new tariff law in placing "sand, crude or manufactured" on the free list and imposing a duty on "silica, crude, $4 per ton; silica, suitable for use as a pigment, $7.50 per ton."

Silica is sand, although not all sand is silica. The attention of Congress was directed to this conflict in the language of the tariff bill by the Tariff Commission long before the measure was enacted into law, but no change was made.

There is no precedent for the ruling, as a duty on silica appears in the 1922 tariff act for the first time.

Cuyuna Iron Mining Companies Plan for Active Winter

Shipping Season Has Closed, but Stockpiling at Many Mines Will Be Continued—Labor Inadequate

Shipments of iron ore from the Cuyuna Range, in Michigan, closed for the season late in November, with the exception of the Bonnie Belle and Sagamore mines, which are both continuing small all-rail shipments. Indications point to the busiest winter since the war. Most of the underground iron mines are now actively stockpiling and several of the open-pit mines are making plans for extensive stripping and lean-ore removal during the winter months. The labor situation is completely reversed from that prevailing twelve months ago. Whereas at that time there were many unemployed and few jobs to be had, some of the mines now anxious to resume capacity production are having great difficulty in procuring workers.

Clement K. Quinn & Co. will carry on big-scale stripping operations at the company's Mahnomen mine, starting soon after Jan. 1. The Portsmouth mine (Coates & Tweed), at Crosby, and the Pennington mine (Todd-Stambaugh Co.) will be operated throughout the winter. Both are open-pit properties which were idle last year.

The Kennedy mine, operated by the Rogers-Brown Ore Co., is operating at full capacity and expects to continue stockpiling throughout the winter. Its present daily hoist is the largest in its history—more than 800 tons per day.

Prosperous Customers Are the Need of Spain's Iron-Ore Industry

It is probable that the Chambers of Mines, created at Madrid, Spain, some months ago for the purpose of playing the same rôle in the mining industry as the Chambers of Commerce in their sphere, will hold a general meeting soon. One of the subjects likely to be discussed is the demand for a bounty on the export of ore (the bounty on coal has whetted many appetites) and the abolition of port and other taxes and export duties. Some persons interested in the mining industry think that these concessions, the cost of which would be extremely onerous for the Treasury, would solve the problem of the serious crisis that exists in the iron-ore industry. Others contend that this is an erroneous idea, asserting that the industry cannot regain its pre-war prosperity until the economic crisis among Spain's former clients is over, and that even then the conditions created by competition on the part of the Morocco, Algerian, and Swedish mines must be considered.

Oriental Consolidated Produced $89,000 in November

Cable advices from Korea give the monthly cleanup for November as $89,000 in gold bullion.

News from Washington

By PAUL WOOTON
Special Correspondent

Coal Commission Will Not Be Involved in Wage Controversies

Statistics Will Be Based Only on Data Supplied by Affidavit—Nationalization Will Be Considered in February

NO FACT-FINDING which can be interpreted as mediating or arbitrating wage-scale disputes will be undertaken by the President's Coal Commission. This point was made emphatically clear by the chairman of the commission, in announcing that the commission had requested John L. Lewis and representatives of the mine workers and certain mine operators to confer with the commission. The chairman declared that the commission is much concerned because of the failure of the Chicago conference to adopt a plan to negotiate wage scales for the coming coal year. He stated that the commission is fully alive to the gravity of the situation and that it had asked representative men on each side to confer with the commission. He pointed out that the conference is to be an informal heart-to-heart talk, in which the members of the commission would urge the parties to the controversy to get together. He declared, however, that the commission will acquaint itself thoroughly with the facts surrounding wage scale matters, as this forms an essential element in the problem to be solved.

Rather than take the chance of having its work discredited by having its figures questioned, the commission will insist on gathering statistics from individual operators, who make the return under oath. The members of the commission realize that their fact-finding activities would be simplified greatly were they to accept the figures of the various local associations. Were they to rely on these figures alone, it is feared that some member of Congress would make an issue of that point and thereby bring about the discrediting of many of the commission's findings. The commission apparently feels that it must be 100 per cent sure of its basic facts and must not leave itself open to destructive criticism, regardless of how trustworthy the members of the commission may regard the figures of local associations.

It is the intention of the commission to conduct formal public hearings on the important controverted issues during February. At these hearings, arguments for and against nationalization of the coal mines, among other things, will be taken up. On the completion of those hearings, the commission expects to visit the mines. As each representative of the operators, the mine workers, wholesalers, retailers and the carriers confer with the commission, each is being asked what he would do were he in the commission's place. This is in line with the plan under which the commission was organized: to gather information.

Arsenic From Arsenopyrite

Several Plants in Operation—Problem Is to Reduce Cost of Recovery

Shortage of white arsenic on the market, which has been made the subject of a Senatorial resolution directing a survey of stocks and possible sources of new supply, has revived interest in official circles at Washington into means of recovering this product direct.

One mine is said to be operating in Utah for the special extraction of arsenic from its ore by a new process, with an annual output of approximately 2,000 tons of arsenic.

Government reports show that direct production of arsenic on a large scale heretofore has been too costly to justify operations, and the 1921 bulletin of the Geological Survey predicted that it would not be attempted unless some finished product can be made directly from the ore.

Direct production, however, has been accomplished in the United States from arsenopyrite in widely separated sections of the country—in Washington, Nevada, Virginia, and New York. Imports from Germany and Japan, selling at prices below the cost of production by old methods of ore mining and arsenic extraction, however, have kept such efforts within narrow confines.

The Utah company now engaged in the direct production of arsenic is operating by a new method said to be much cheaper than former methods, mining scorodite from a mine which failed for other purposes. Lime arsenate is obtained at the reduction plant. Similar deposits have been worked by other methods at Jardine, Mont.; Carmel, N. Y., and Brenton, Va. At Toy, Nev., an old tungsten plant has been converted to arsenic production.

As arsenopyrite is found in connection with many precious metal ores, the field for direct production of arsenic appears wide.

The byproduct output of arsenic has been chiefly from copper and lead smelters.

The future of arsenic production, from the mining standpoint, apparently depends upon lowered production costs and maintenance of the demand, which in some years has not been sufficient to absorb all of the byproduct output of the United States. Export demands holds possibilities which may help attract capital to experiment.

War Minerals Relief Commission Details Progress

Report Shows Distribution of $1,681,817.49 of Appropriations Under Amended Act

Under the amended War Minerals Relief Act, awards totaling $1,681,817.49 had been made up to and including Nov. 30, according to a report submitted to Congress by the Secretary of the Interior. The secretary's report calls attention to the fact that these awards represent 32.7 per cent of the amounts claimed. Secretary Fall sets forth the progress in the following table:

	Number of Claims	Amount Claimed	Award Recommended
Rehearings filed.	906	$13,090,788.29	
[1] Admitted to consideration under amendment.....	60	1,141,327.27	
Totals.....	966	$14,232,109.56	
Recommended for award or rejection by commission.....	321	6,499,910.84	$1,613,925.86
[2] Pending.....	74	1,363,768.41	47,955.10
			Amount Awarded
Awards by secretary.....	247	5,136,142.43	$1,681,817.49
To be adjusted...	645	7,732,198.72	
Cost of administration.....			$50,078.66
Balance of appropriation Nov. 30, 1922...			3,111,615.52
Refunds to government, deducted from awards:			
Railroad administration.....			8,025.80

[1] Claims filed subsequent to June 2, 1919, but mailed on or before that date.

[2] When a recommendation is made by the commission the claimant is furnished with a copy and notified of his right to file exceptions. All claims are held in the office of the commission at least ten days pending the receipt of an acceptance or brief of exceptions, after which they are fowarded to the secretary for his consideration and final determination.

Washington Officials Verify Reports of Shortage of Mine Labor

Telegraphic reports to the United States employment service covering the employment situation for November indicate that the shortage of workers in metal mines continues. These reports also reveal that there is increasing activity in practically all of the metal mining camps in the country, with the inability to secure labor as one of the limiting factors.

Dull Week for War Minerals Relief Commission

Subject to the approval of the Secretary of the Interior, the War Minerals Relief Commission has recommended awards as follows:

William A. Heuser, Georgetown, Calif., $336; Frank L. Lasswell, Latrobe, Calif., $606.72; M. A. Kelley, New Castle, Calif., $233.

The Commissioner recommends the disallowance of the claim of Hoff & Ehler, of Plymouth, Calif., because no net loss was proved. Disallowance was recommended also in the case of Julian E. Esper, of Cool, Calif., who failed to establish commercial importance.

News by Mining Districts

By Special Correspondents in the Field

London Letter

Pahang Consolidated Profit Dwindles—Zinc Corporation Will Resume Mining

BY W. A. DOMAN

London, Dec. 1.—Owing to the low price of tin ruling during the twelve months ended July last—the average net realized was £100 per ton, against £132 and £203 in the two preceding years—the Pahang Consolidated earned a mine profit of only £2,162, against £9,260 in the previous year and £152,297 at July 31, 1920. The quantity of ore treated was 170,900 tons for a yield of 2,534.7 tons of black tin or 1.48 per cent. Alluvial and river tin obtained was 167.3 tons, making the total production 2,702 tons. For the four previous years (working backward), the percentages of tin were 1.33, 1.23, 0.76, and 1.06, so that the twelve months under review showed an improvement from the yield standpoint. Since the end of March the mill has worked only two-thirds time. The management made strenuous efforts to reduce expenditure, and so far succeeded as to cut it from 33s. 10d. per ton in 1920-21 to 29s. 3d. Only Willink's mine was worked at a profit; the outside mines were closed down, a large number of workmen were discharged, and the batteries were run short time. Development amounted to 28,868 ft., against 42,087 ft. the year before, and at the 600 level an additional 1,120 ft. of ore was opened up. Willink's shaft, which at July, 1921, had reached a depth of 1,045 ft. below adit level, was carried to the 1,200 level, and will be connected with the level from Nicholson's shaft, the face of the drive being within 125 ft. The footage sunk cost £2,891. On some of the lodes, development was prevented owing to the danger of striking water. To cope with the water problem, a Cornish pump was ordered in July, 1919, and was only completed in July last. Costing £79,307, it is expected to effect substantial savings. With regard to the future, there are good prospects at Willink's of finding more ore to the east in the lower levels, and possibly to the northeast in the upper levels. A promising outcrop was found on the Gakak Creek, and a new alluvial area has been discovered. When expenses approach to normal, a new shaft will be sunk in the Kabang valley.

The British Broken Hill Proprietary is a London company with a capital of £315,000 in £1 shares, and 60,000 shares of 8s. each. Forced into an unfavorable contract with the Broken Hill Associated Smelters Proprietary during the war, the "British" company cannot carry on effectively, and very vigorous protests have been made. It is now officially announced that a new company is being formed in Australia (Adelaide) to purchase the British Broken Hill undertaking out and out at 35s. per share. Holders may take either a £1 share plus 15s. cash, or 35s. in cash. It is expected that the offer will be accepted.

Having virtually exhausted the accumulation of zinc tailings, the Zinc Corporation proposes to resume mining operations for a trial period of six months. At present the Edmunds Award stands in the way of economical working, and a continuance beyond the six months will depend upon conditions.

Melbourne Letter

Queensland Fails to Improve Financial Results by Government Operation of Mines

BY PETER G. TAIT

Melbourne, Nov. 11.—The Queensland Government is strongly socialistic and has embarked on a number of enterprises, of which the Chillagoe mines and smelting works is one. The works were erected by the old Chillagoe Proprietary Co., founded in 1898 and afterward reconstructed as the Chillagoe Ry. & Mines, Ltd., and later as Chillagoe, Ltd. The first general manager was George Stewart, formerly of the Broken Hill Proprietary. The company obtained a concession to build a railway from Mareeba, on the government line, to Etheridge, a distance of 248 miles, and under its various titles struggled on for years, but the mines did not develop as anticipated, and after spending large sums of money, in June, 1919, the whole of the assets with the exception of the Mount Mulligan coal area, were sold to the government for £475,000. The government also took over the liability of the Etheridge railway debentures (£225,000).

The government has since acquired the Mungana mines, an offshoot of Chillagoe, and is busily developing the Girofla lead mines, the Chillagoe Consols lead mine, and the Lady Jane copper mine, which was shut down by the Mungana Co. owing to the firing of the orebody. These properties are expected to become the main producers for the smelters. A monthly output of 600 tons of silver-lead bullion is confidently hoped for by the management. The copper furnaces are at present closed down, but are expected to resume soon. The government's original policy of running the works to treat the ore from tribute parties and others failed to materialize, due, in part at least, to the fact that many men would sooner have a government job, and in part to the fact that capital is required to bring mines to the productive stage. With the experience of Chillagoe and other companies on the field, investors are naturally shy.

After several years' experience it cannot be said that the government has fared any better, financially, than its predecessors. For the year ended June 30, 1922, the output was 309 tons of lead bullion and 674 tons of blister copper. The financial results have not yet been made public, but it seems almost certain that a heavy loss will again be shown. For the previous year the loss was £49,450.

The government also controls the tin-smelting works at Irvinebank, formerly the property of the Irvinebank Mining Co., and arsenic works at Jibbenbar, but these are also in the same category so far as profits are concerned.

Montreal Letter

Analysis of Teck-Hughes Report

BY ALEXANDER GRAY

International interest created in the Teck-Hughes Gold Mines, of Kirkland Lake, Ontario, may not be fully justified in the eighth annual report, but the correct presentation of the difficulties accompanying operations, and the lucid analysis of costs, deserve commendation. Without emphasizing the improved mining position and outlook, and leaving shareholders to draw their own conclusions as to the disparity between market capitalization and the ore-reserve and liquid asset position, the directors and general superintendent, D. L. H. Forbes, offer a great deal that is helpfully instructive about a mine that is disclosing greater tonnage of ore of exceptional grade after years of varying if not disappointing results.

Concededly, operations were somewhat intermittent. Although the fiscal year begins with September, it was not until January that the grade of ore mined and mill capacity approached requirements. Starting with February the tonnage treated was larger, but the grade was not up to expectations. In July the development on the lower level raised the grade to $23.14—and it has been higher since. So rich was the ore drawn thereafter from the sixth and seventh levels, that the management preferred to sacrifice tonnage for recovery. Instead of maximum capacity, therefore, the tonnage was reduced to 100—subsequently to 88—per day, and notwithstanding that the September output was $118,000. Meanwhile, No. 3, the productive orebody, and No. 1, paralleling it, together with two branch veins on the sixth and seventh levels, were disclosing "high-grade oreshoots of considerable length." "On the whole," writes Mr. Forbes, "the year's operations were highly satisfactory and the finding of important orebodies in the No. 1 Vein at the 7th level is encouraging in relation to the future of the mine at greater depth."

In his elucidation of the operations, Mr. Forbes turned the spotlight upon the company's costs and taxation. The 43,300 tons treated yielded $481,144.02, or $11.11 per ton. Including exchange premiums and interest, the gross revenue for the year was $501,407.63, or $11.58 per ton. The total direct operating cost was $306,912.53, or $7.09 per ton; while indirect charges, such as depreciation, new construction, financial charges and extraordinary expenses

amounted to $82,672.51, or $1.91 per ton, making the total of direct and indirect charges $389,585.04, or $9.00 per ton, and leaving a net revenue of $111,822.59, or $2.58 per ton.

While special charges due to capital readjustments are not likely to recur, the working cost should be materially reduced by treating higher-grade ore. Reserves of 79,974 tons, estimated at $1,183,176, included in which is a broken-ore reserve of 19,213, reflect the progress being made. Directors announce it to be the policy of the management "to continue sinking and opening up lower levels and to continue development of existing levels as rapidly as possible."

ONTARIO

Nipissing Joins Record Makers—Output 328,000 Oz. in November

Cobalt—November was Nipissing's record month for the year, with a production of 328,000 oz., of an estimated net value of $212,016. An extension of vein 490 has been found from the Meyer shaft where it shows 4 in. of 2,500-oz. ore for a length of 45 ft.

The La Rose has started a new shaft on the Violet property which will be sunk to a depth of about 500 ft. Underground development is also to be restarted at the University and "J. B. 4" properties, which have been closed down since the fire.

Coniagas is preparing to start work on the Beaver, which it recently leased. There is considerable broken ore underground, and milling can be started before the lower levels below the contact are unwatered.

Kirkland Land—The Continental has decided to sink a shaft on the recently discovered vein on its Kirkland properties. A road has been cut, and machinery will be brought in over the snow.

The Blue Quartz mine, in the Painkiller Lake section, will install a new hoist and 500-cu.ft. compressor.

Porcupine — During November the Dome treated 32,100 tons of ore, with an average recovery of $11 per ton, or a total recovery of $353,495, compared with $382,712 in October. The directors have announced that in 1923 the dividend will be raised to $4 per year on the present shares. As a reorganization is to be made which involves giving four new shares for each of the present shares, the dividend will be $1 a year on the new stock. During the coming year the company will do 17,000 ft. of underground work and 17,000 ft. of diamond drilling.

Hollinger closes its year with the declaration of a 1 per cent dividend payable Dec. 31. This makes 13 per cent for the year, or a total of $3,198,000. Indications are that for 1922 the company will treat 1,500,000 tons of $8.60 ore and recover $12,750,000.

Four diamond drills are at work on the Edwards property, east of the Dome, and it is understood that some encouraging values have been encountered.

BRITISH COLUMBIA

Armstead Gets Control of Utica Property

Nelson — Telegraphic report from Kaslo states that Major H. H. Armstead has purchased a controlling number of shares, 1,950,000 out of a total of 3,000,000, in the Utica mine at 9c. per share, payable in eighteen months, and that he will give 50 per cent royalty on all ore produced during the period of the option. This arrangement was ratified at a general meeting of the shareholders on Nov. 29. It would appear that Major Armstead has raised his original bid, which was 7½c. per share, payable in twelve months. The terms on which he secured the shares are exactly those offered by O. C. Thompson, the present lessee of the mine.

Stewart—In continuing the tunnel at the Virginia group, A. G Larsen, who recently acquired the property, has opened up 8 ft. of good milling ore.

The tunnel at the Riverside group is being advanced at the rate of about 10 ft. daily. It is now in 400 ft., and it is expected that it will cut the lode at a depth of 350 ft. at about 800 ft. from the portal.

The American Mining & Milling Co. is making preparations for rawhiding ore from its Fish Creek property. The company will ship steadily through the winter months.

MANITOBA

Elbow Lake May Have Railroad

Elbow Lake—The district is receiving much attention from mining men and investors, and many claims are changing hands at high figures. The U. S. S. R. & M. interests have already made a large investment in the country, and an English syndicate recently bought forty-one claims for a reported consideration of $750,000. The proposition to build a railway, 80 miles long, from the Hudson Bay line to the mining area is under consideration by the Manitoba government. The new Premier, William Bracken, who represents The Pas district in the Legislature, is said to be strongly in favor of the proposition.

MEXICO

Sierra Consolidated Delinquents Will Be Sold Out

Ocampo—The Sierra Consolidated Company will sell shares with delinquent assessment on Jan. 10. The mine was taken over in 1909 and development work was prosecuted actively for over two years, when the properties were closed down on account of revolutionary disturbances. The ores are gold and silver, and reserves are estimated at 100,000 tons, averaging $15 gross value per ton. The mines are well equipped and operated by electric current from the company's generating station 6 miles from here on one of the company's timber tracts. Machinery for the new 100-ton cyanide mill is on the ground, but has never been erected. The history of the district has been the working of a succession of rich bonanzas, with lower-grade material between. They have been demonstrated to persist to considerable depths below the outcrops, and while the district is reputed to have produced over $25,000,000 in bullion, the veins have been only partially explored.

Ixtlan del Rio—The Humboldt Mining Co. is building a new trail from San Marcos to its mine. Machinery, including an engine, compressor, drills and pipes, and necessary supplies are in Manzanillo, en route to San Marcos. H. M. Payne is manager.

CALIFORNIA

New Plant for Cleo, Near Sonora

Sonora—A new plant is to be erected at the Cleo mine. Both mill and hoist were destroyed by fire some months ago.

A magnesite deposit is being opened up near Chinese Camp by J. J. Regan and F. E. Cummings.

Scales—At Scales, Sierra County, equipment is being installed for placer operations on the Fairplay, Scales, and Council claims. F. E. Declezen is directing operations.

COLORADO

Telluride's Output Increases; Cripple Creek's Decreases

Cripple Creek—Contrary to general predictions that November output would show a substantial increase over the preceding month, actual figures show a slight falling off both in tonnage and valuation. The Portland mill in November treated 11,483 tons, with an average value of $2.83, compared with 10,137 tons in October, with an average value of $3.13. The Golden Cycle treated 23,000 tons in November, as compared with 25,000 tons in October, the average value in each instance being $15 per ton. With active mining operations begun by the Tonopah-Ajax Co. December is expected to show a material increase in tonnage.

The Portland Gold Mining Co. is now preparing to sink its 2,650-ft. shaft an additional 135 ft. The work will begin as soon as the present sump can be cleaned out.

Telluride—Shipments of concentrates from the Smuggler and Tomboy for the month ending Nov. 30 totaled 115 cars, a gain over the previous month of 10 cars and a like gain over the record for the same period last year. Considering the lack of cars, the showing is considered good. The shipments were divided as follows: Smuggler-Union 65, Tomboy 50.

Montrose—Arp Bros., who are operating a lease on the old Cashin mine near the Utah border, have shipped by express to the Omaha smelter 105 sacks of high-grade ore. Previous to this shipment, 10 sacks, sent to the Durango smelter, netted approximately $2,000. Smelter officials advised that the ore be sent to the Omaha smelter, as it was better equipped to treat the ore, which contains native silver and copper.

ARIZONA

Southwest Metals Company Making 1,200,000 lb. of Copper Monthly

Kingman—Workable ore has been encountered at the Bonanza property, which is in the Silver Creek placer field, west of Oatman. The development has been under the direction of J. J. McCarty. The ore is found at a depth of 14 ft.

Concentrate containing 14 per cent copper and $130 gold and silver is being shipped from the new Highland mill to the Humboldt smelter. The company's lead-zinc ores are not being milled.

Bisbee—During November, 36 carloads of ore were shipped to the Douglas smelter by leasers of the Commonwealth mine, at Pearce.

The Flux mill, near Patagonia, has been dismantled, and its machinery shipped to a point near Magdalena, Sonora, Mexico.

Jerome—The roundhouse of the Verde Tunnel & Smelter Co. was burned to the ground recently, with a loss of $60,000.

The steam shovels on the 150-level shelf of the United Verde mine have cut a new orebody, which is believed to be an extension of the Wade Hampton ore. The ore is 125 ft. wide, contains about 4 per cent copper, and a vertical face of 75 ft. has been exposed. The shovels are expected to break into the first of the fire stopes soon.

Humboldt—The smelter of the Southwest Metals Co. is receiving about 400 tons per day of ore and concentrate. The Swanson mill, in the northern part of Yuma County, ships about 400 tons of concentrate monthly. The Coyote Mining Co., at Randsburg, Calif., shipped three carloads of high-grade silver ore recently, and other ore is received from Pioche, Nev. About 70 tons a day is expected from the Sheldon mine, at Walker, as soon as the repairing of the old Poland tunnel is completed. The product of this smelter is about 1,200,000 lb. of copper per month, which contains about $200 gold and silver per ton.

The Howard Silver Mining Co. has shipped its first car of ore to the Humboldt smelter, and is building a mill on its property near Turkey. The ore carries lead and zinc; the reserve is said to be ample to supply the mill for one year.

Globe—Drifts on the vein on the 1,700 level of the Arizona Commercial Mining Co. mine at Copper Hill have attained a total length of 150 ft. and have all been in the same high-grade sulphide ore as was encountered by the first crosscut near the shaft. This development is regarded as important, as this is the deepest level in the mine. It is expected that work will be started from the shaft on the 1,800 level sometime in February. This mine is producing about 200 tons of ore per day. The output is shipped to the Old Dominion mill for concentrating. Production will probably be increased to 300 tons.

NEVADA

Reports of New Smelting Plant for Eureka Persist

Virginia City—The mill of the United Comstock Mines Co. is now treating an average of 1,500 tons of ore per day and will likely reach maximum tonnage possible with the present unit, or 2,500 tons per day, some time in February, 1923. About 500 men are employed in mine and mill. Ore is being mined from the Imperial, Yellow Jacket, Confidence, and Alpha mines, with a large tonnage coming from the surface glory holes. The new ore pass in the Yellow Jacket is to be equipped with two seven-ton skips, operating in counter-balance. This will obviate frequent and costly repairs to chute linings.

New mill of the Nevada Consolidated company at McGill, photographed five months after the fire that destroyed the old plant in July

Eureka—Reports persist that financial arrangements are being completed in New York for the purchase of the Eureka-Nevada railway, and for the construction of a 600-ton smelter at Eureka. There is known to be a large tonnage of low-grade ore in the mines which cannot be handled at a profit under present conditions, and possibilities for the discovery of rich orebodies have been confirmed by capable geologists and engineers.

Tonopah—The mill of the Tonopah Mining Co., which was damaged by the collapse of one of the large cyanide tanks about two weeks ago, is again in operation.

Battle Mountain—Lander County is coming to the front as a precious-metals producer. Three mines, the Hilltop, Cortez, and Betty O'Neal, have been developed and made ready for production. The Betty O'Neal is now operating its 100-ton flotation plant, completed a month ago. The Hilltop is rushing work on a flotation mill of like capacity, which will be placed in operation by February, 1923. The Cortez has begun on a 150-ton plant and expects to be milling during the coming summer.

UTAH

Iron Blossom Lessees Ship High Grade From Tintic

Eureka—Tintic shipments for the week ended Dec. 2 amounted to 170 cars compared with 167 cars during the week preceding. Shippers were: Chief Consolidated, 66 cars; Tintic Standard, 43; Iron Blossom, 10; Eagle & Blue Bell, 10; Victoria, 9; Dragon, 8; Colorado, 7; Eureka Mines, 6; Bullion Beck, 4; Swansea, 3; Uncle Sam, 1; Centennial Eureka, 1; Yankee, 1; Alaska, 1.

The drift on the 1,300 level of the Grand Central has almost reached Plutus ground, which like the Grand Central itself is owned by the Chief interests. The oreshoot is widening, and the grade of the ore is growing better.

Eight tons of exceptionally rich ore shipped by lessees at the Iron Blossom the week ended Dec. 2, is stated to have carried 2,130 oz. of silver to the ton, and some gold. The ore was taken from a high-grade streak, and sacked and guarded, as even this small shipment will bring over $17,000. Half of the value goes to the company and half to the lessee. The same lessees some time ago made several shipments of similar ore, one of which brought about $35,000. Conditions at the mine are good, and the largest number of men in several years is working. The company is doing new development work to the east of the older deposits where geological indications are good.

Park City—Shipments for the week ended Dec. 2 amount to 3,377 tons, compared with 4,021 tons the week preceding. Shippers were: Park-Utah, 1,062 tons; Silver King Coalition, 1,027; Park City Mining & Smelting, 868; Ontario, 420.

Bingham—Shipments for the week ended Dec. 2—exclusive of Utah Copper and Utah Consolidated shipments—amounted to 84 cars. Shippers were: United States mines, 46 cars; Utah Apex, 23; Bingham Mines, 8; Montana-Bingham, 7.

MONTANA

Emma Mine Ships 250 Tons Daily

Butte—The Anaconda Copper Mining Co. has cut the main zinc orebody in a country-rock winze sunk from the bottom or 1,000 level of Emma mine which it operates for the Butte Copper & Zinc Co. It is reported that the ore in winze assays 20 per cent zinc, 10 per cent lead and 10 oz. of silver a ton. The Butte Copper & Zinc Co. is planning to reopen the Ophir mine, in the southwestern part of the city, so as to develop the Emma at further depth and save heavy hauling charges to the railroad.

The Anaconda company is mining about 250 tons of zinc ore per day from the Emma. The ore contains 5 oz. of silver, which can be sold under the Pittman Act. The Butte Copper & Zinc Co. usually is paid for about 75 per cent of the silver, so that the cost of mining the zinc ore is nearly covered. This ore is shipped to the Washoe plant, where Anaconda concentrates it and recovers the zinc electrolytically at its plant at Great Falls.

Earnings are limited by inability to get miners. The shortage of labor is in a measure being overcome gradually by steady influx of miners to Butte during last few weeks. Anaconda is willing to take all the zinc that Butte Copper & Zinc can produce.

MICHIGAN

Lake Districts Shipped 13,478,000 Lb. of Copper in November

By M. W. Youngs

Houghton—Copper shipments by boat out of the Michigan district were heavy in November, 13,478,000 lb. going forward. The Calumet & Hecla group of mines shipped 7,588,000 lb. from the C. & H. smelter at Torch Lake. In addition, Calumet & Hecla shipped 1,240,000 lb. from the Copper Export Association storage at Dollar Bay. Copper Range, Mohawk and Wolverine shipped a total of 1,970,000 lb., and Quicy sent out 2,680,000.

Final preparations are being made for resumption of sinking in Gratiot No. 2 shaft, Seneca, and this work should start in a week or ten days. A pipe line from the Gratiot River to the shaft is nearing completion, and the railroad from the shaft to the Mineral Range is complete with the exception of 400 ft. Work on the new surface plant is progressing favorably, but the old hoist will be used temporarily in sinking until the new hoist is ready. Drifting continues south on the 11th level in Gratiot and north on the 13th. Drifts continue north toward Gratiot from the Seneca shaft at the 3rd, 5th, and 7th levels, all of which are in commercial rock. The 3d level drift is in 2,830 ft. It is with this drift that Gratiot No. 2 shaft will be connected at depth, to allow better ventilation and more territory for stoping. The shaft is now bottomed at the 13th level, and it will be sunk 2,000 ft. to connect with the Seneca 3d level opening.

Gogebic Range

Bad Ground Bends Steel Sets

Ironwood—The No. 1 Puritan shaft, which is being sunk 650 ft. below the 18th level, has developed trouble due to swelling ground. The shaft is 7x17 ft. inside of timbers down to the 18th level and below there is 7x18 ft.; it is inclined at 66 deg. and is in the slate back in the foot wall. In most places this slate stands up well, but where it is fractured much it swells and scales off. The shaft has run into one of these zones, and several of the heavy steel sets have been bent soon after they were hung. The reinforced concrete lath is being removed and the shaft being given a coat of gunite to see if cutting off the air will prevent further swelling.

Installation of new electrical equipment at the Eureka mine, at Ramsay, is nearing completion, and it is expected that it will be in operation about the first of the year. It consists of three large hoists, one for cages and two for skips. An air compressor and two underground pumps are situated on the 12th and 21st levels.

MINNESOTA

Mesabi Range

New Steam Shovels, Locomotives and Cars Are Ordered

Chisholm—The Orwell Mining Co., a subsidiary of the Todd-Stambaugh Iron Co., has placed an order for equipment for pit operations at the company's Dunwoody property. The order includes one No. 300 model Marion steam shovel, two Baldwin locomotives, and fifteen 30-yd. Western steel dump cars. The equipment will be used in the stripping program this winter.

Biwabik—The Belgrade mine has again been placed on an operating basis by the Pickands Mather Co. This property has been idle for over a year, but present plans call for a capacity production of 500 tons per day.

Tower—The diamond-drill work that is being conducted by the Independent Mining Co. is meeting with success. In several holes ore has been ancountered of high iron content, but at present no great depth has been reached.

Cuyuna Range

Ironton—The Maroco mine (Marquette Ore Co.) closed its season with a shipment of upward of 150,000 tons of high phosphorus wash ore. This material was shipped all-rail, to the National Coke & Chemical Co., Granite City, Ill.

Riverton—John A. Savage & Co. has completed a successful initial season at its immense iron-ore drying plant at the Sagamore mine. The plant was completed in mid-season at a cost of approximately $250,000. The two 78-ft. drier tubes were operated during the last three months of the shipping season, with a capacity output of over 100 cars per day.

ALABAMA

Birmingham Iron Industry Looks for Greatest Activity in History

By George Huntington Clark

Alabama and the Burmingham district approach the close of the year in active preparation for an anticipated period of the largest pig iron production in its history. November output has also been the largest of the year.

The Tennessee Coal Iron & R.R. Co. has increased its iron-making capacity by the recent blowing in of its new No. 2 stack at Ensley, rated at 550 tons, the largest furnace in the South and one of the largest iron making units in operation.

The number of active blast furnaces on Dec. 1 was twenty-three, twenty-two being on coke and one on charcoal iron; this, out of a total of thirty-six available furnaces, the average district number undergoing current repairs. Several stacks are of obsolete type and are not used.

Eleven openhearth furnaces are at present active out of a total of fifteen.

Anticipated additions to furnace activities in the early months of 1923 comprise: the third furnace of the Republic Iron & Steel Co., (making its full quota), conditioned on restored transportation facilities; the second furnace of the Alabama company, which has been undergoing repairs since July, delayed by non-delivery of materials; and No. 3 stack of the Sloss-Sheffield, on which current repairs are about completed, restoring that company to its full five-furnace basis. The Woodward Iron Co. continues with all five of its furnaces in blast, four on foundry and one on basic iron.

JOPLIN MIAMI DISTRICT

More Concentrators Are Started

Joplin—The Butte-Kansas Co. has started its No. 1 mill at Waco, Mo., the No. 2, known as the Acme, having been in operation about two months. A new double compartment shaft will be sunk at the No. 1 property to a depth of 350 ft., and as soon as this shaft is completed a third mill will be built. L. P. Buchanan, of Joplin, is resident director.

The More Lead Co. is building a mill on "the installment plan" at its property directly south of Baxter, Kan. At present it has only a crusher, a set of rolls, and one rougher jig, supplemented with two hand jigs, but it plans building a complete mill later.

The Boyd-Wilson Zinc Co. has completed and placed in operation a 250-ton concentrator at Wentworth, part of it being moved from the old Boyd mine, in that field. The property is on a sixty-acre lease of the Burnett land, which has been thoroughly drilled. There is a field shaft and a mill shaft; the field shaft will be sunk deeper.

Members of the Lucky Kid Mining Co. and others have taken over the Chicago-Miami mine and lease, and will repair the mill and place it in operation. A. C. Moses, of Joplin, is local representative of the Lucky Kid Co

THE MARKET REPORT

Daily Prices of Metals

Dec.	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
7	13.625@13.75	36.25	37.50	7.10	6.95@6.975	7.10
8	13.625@13.75	36.25	37.50	7.10	6.925@6.95	7.075
9	13.65 @13.75	35.125	37.375	7.10	6.95	7.00@7.075
11	13.65 @13.75	36.25	37.375	7.10	6.90@6.925	7.00
12	13.65 @13.75	35.875	37.00	7.10	6.90	7.00
13	13 75@13.875	36.375	37.375	7.10	6.90	7.00

*These prices correspond to the following quotations for copper delivered: Dec. 7th and 8th, 13.875@14c.; 9th, 11th and 12th, 13.90@14c.; 13th, 14@14.125c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Federal bureaus in Washington which are interested in the mining industries.

London

Dec.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
7	62½	63¼	69½	180½	181½	26	25½	38¾	35½
8	62½	63⅛	69½	180¾	181¾	26	25¼	38¼	35¼
11	62⅝	63¼	69½	178⅞	179⅝	26	25¼	38¼	35
12	62½	63¼	69	175½	176¾	26	25⅛	37⅞	34⅞
13	62¼	62⅞	68½	176	177⅛	26	25¼	37¼	34¼

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	Dec.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
7	4.56¼	99⅝	64⅜	31⅞	11	4.57¼	99⅝	64⅝	31 13/16
8	4.56¼	99⅝	64¼	31 13/16	12	4.61½	99⅝	64½	31 15/16
9	4.56¾	99⅝	64½	31⅞		4.67¼	99⅝	64	30 15/16

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, Dec. 13, 1922

Copper and tin are somewhat stronger than a week ago, but the tendency in lead and zinc is slightly easier. No change of importance is discernible in domestic metal consumption, which continues excellent, and foreign affairs seem to be on the mend. Sterling exchange is remarkably strong, and it is predicted that it will soon go to par.

Copper

The copper market is perceptibly stronger, with quotations one-eighth to one-fourth of a cent higher than a week ago. As late as Friday consumers situated near New York could obtain copper for 13⅞c. delivered, but in the last three days this price is not reported by any one. In fact, many producers are out of the market at 14c., and are making firm quotations of 14⅛c. Several sales at that level for first-quarter delivery are reported today. It would probably be difficult today to pick up any copper for delivery beyond February at the 14c. level. Sales have been somewhat better than usual, though the orders have not been phenomenal. The tendency is distinctly upward, with producers more optimistic than usual. There is now practically no disposition to shade prices to obtain orders.

Export demand has also been better, with the orders well distributed in Continental Europe. Germany is again a buyer of importance.

Lead

The official contract price of the American Smelting & Refining Co. continues at 7.10c., New York.

Plenty of lead is now available at the price set by the leading interest, and the high quotations published in some of the metal papers seem to be purely nominal. For spot lead, a slight premium might be asked, and for delivery three or four months in the future 7.125@7.15c. would probably have to be paid. Reports indicate that ample supplies are expected in this market to take care of all anticipated business. Demand continues satisfactory; the middle and end of December are usually rather bare of orders.

The St. Louis market has not been active and has declined slightly. On orders of any size, it would probably have been possible to do 6.90c. through practically all of the week. Business at intermediate points, such as Pittsburgh, has been placed at figures somewhat under the St. Louis price, plus freight.

Zinc

Demand from abroad, which has been an important support of the market for several weeks, has decreased, and this, coupled with a lack of orders from galvanizers, has caused prices to sag. Brass manufacturers have been the most important buyers during the week. Sales of zinc were made almost wholly for forward shipment from January to March. Spot metal, for which there was an insignificant demand, commanded premiums of 10 to 15 points. Sales of high-grade zinc have been made at from 7.75 to 8.25c. per lb. with 30c. per 100 lb. freight allowance. Producers have current production well sold up.

The statistics for November of the American Zinc Institute show that zinc is still in an excellent position, although a slight increase in stocks occurred. Stock on hand Nov. 1 was 18,043 tons; production was 40,200; shipments were 38,746; and stock on hand Nov. 30 was 19,497.

Tin

Consumers remain aloof from the market, and plenty of metal for prompt delivery is looking for a buyer in this market. Shadings of the price do not prove tempting. For this reason the price of spot tin is now one-fourth to one-half cent under the quotation for forward deliveries.

Arrivals of tin, in long tons: Dec. 5th, China, 150; Liverpool, 50; Java, 100; Straits, 25; 6th, China, 10; 7th, Straits, 70; 8th, Straits, 1,125; China, 300; 11th, Straits, 1,075; 12th, Java,

850; Liverpool, 50. Total, December, 4,885.

Gold

Gold in London: Dec. 7th, 90s. 1d.; 8th, 90s. 1d.; 11th, 90s. 3d.; 12th, 89s. 7d.; 13th, 88s. 5d.

Foreign Exchange

Sterling has advanced again, and the predictions made same months ago that it would reach par by the first of 1923 are recalled. Other exchanges are also slightly stronger than a week ago. On Tuesday, Dec. 12, cable quotations on francs were 7.06c.; lire, 4.985c.; marks, 0.0122c.; and Canadian dollars, ⅝ per cent discount.

Silver

The London spot quotation has fallen 1 7/16d. during the last week, as a result of further sales from China and the Indian bazaars. Under ordinary conditions this drop would have been reflected in the New York price by a decline of nearly 3c., but the phenomenal advance in sterling exchange during this period has caused the New York market to hold steady, and at times even to show considerable strength.

Mexican Dollars—Dec. 7th, 49¼; 8th, 49; 9th, 49¼; 11th, 49⅜; 12th, 49¼; 13th, 48⅞.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—General market for 99 per cent grade, 22@23c. per lb. London quotations, £92 10s.

Antimony — Chinese and Japanese brands, 6.40c. W. C. C. 6.75@7.25c. Cookson's "C" grade, spot, 8⅝@9c. Chinese needle antimony, lump, nominal, 4.50c. per lb. Standard powdered needle antimony (200 mesh), 5½c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 6.75@7c. Market more active.

Bismuth—$2.45 per lb. London quotes 10s.

Cadmium—$1.15 per lb. London quotes 4s. 6d. @ 5s. 6d.

Iridium—$240@$275 per oz.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Outside market quiet at 32@34c. per lb.

Palladium—$60 per oz. London, £17.

Platinum—$108 per oz. London, £23.

Quicksilver—$71@$72 per 75-lb. flask. San Francsico wires $69.70. London, £12.

Selenium—$2 per lb.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Tellurium** and **Thallium** are unchanged from prices given Dec. 2.

Metallic Ores

Chrome Ore—Indian chrome ore, $18.50 per ton, c.i.f. Atlantic ports. Rhodesian and New Caledonian, $26 per ton. Market quiet.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $5 per long ton; old bed concentrates, 63 per cent, $5 25; Harmony, cobbed, 63 per cent, $5.25; new bed low phosphorus, 65 per cent, $7.50.

Manganese Ore—29c. per long ton unit, seaport, plus duty. Chemical ore, $75@$80 per gross ton.

Molybdenum Ore—70c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates.

Tungsten Ore — Wolframite, $7.50; scheelite, $8.50@$8.75 per unit of WO_3, f.o.b. New York.

Iron ore, Tantalum, Titanium, Uranium, Vanadium, and **Zircon** ore are unchanged from the quotations published Dec. 2.

Zinc and Lead Ore Markets

Joplin, Mo., Dec. 9—Zinc blende, per ton, high, $47.45; basis 60 per cent zinc, premium, $45@$46; Prime Western, $43@$44; fines and slimes, $42@$40; average settling price, all grades of blende, $41.35; calamine, basis 40 per cent zinc, $22@$23.

Lead, high, $94.50; basis 80 per cent lead, $93; average settling price, all grades of lead, $88.87 per ton.

Shipments for the week: Blende, 18,671; calamine, 85; lead, 3,093 tons. Value, all ores the week, $1,045,480.

The shipments of the last two weeks exceeded 36,400 tons, and purchases were only 21,600 tons, while the production was 29,200 tons. In the fortnight stocks have decreased 7,000 tons.

Platteville, Wis., Dec. 8—Blende, basis 60 per cent zinc, $46.50 per ton. Lead, basis 80 per cent lead, $93 per ton. Shipments for the week: Blende, 4,811 tons; lead, none. Shipments for the year: Blende, 31,011; lead, 1,348 tons. Shipped during the week to separating plants, 961 tons blende.

Non-Metallic Minerals

China Clay (Kaolin)—Crude, $6@$8; washed, $8@$9; powdered, $12@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $14@$20, f.o.b. Virginia points. Imported lump, $15@$22, f.o.b. American ports; powdered, $40@$45, f.o.b., New York. 1A grade, refined, $14@$15 per ton, Delaware. Canadian, in lumps, $16@$18, f.o.b. Quebec points.

Fluorspar — Fluxing gravel, 85 per cent CaF_2 and not over 5 per cent silica, $21.50, f.o.b. mines; not over 6 per cent silica, $21; 80 per cent grade, not over 5 per cent silica, $20; ground acid grade, $45 in bulk; ground enameling grade, $35 in bulk; packages, $4 extra, all f.o.b. mines, Illinois. No. 1 lump, $30; No. 2, lump, $25, f.o.b. Illinois mines.

Magnesite—$15 per ton for crude, $40 for unground calcined magnesite, f.o.b. California points. Northwest American magnesite industry shut down. Dead-burned magnesite grains, $43.50 per net ton, f.o.b. Baltimore; $45, Chester, Pa. Demand increasing for white plastic magnesite.

Mica—Scrap material, $22 per short ton, New Hampshire points; disk, 15c. per lb.; washer, 8@10c. For other mica quotations see issue of Dec. 2.

Talc—Ground from 150 to 200 mesh, $6.50@$8.50 per ton, bags extra ($1 for 50-lb. paper bags or 10c. each for burlap bags, 12 to the ton), f.o.b. Vermont. Competition keen. Demand has dropped about 20 per cent lately. For other talc prices see issue of Dec. 2.

Asbestos, Barytes, Bauxite, Chalk, Diatomaceous Earth, Emery, Feldspar, Fuller's Earth, Graphite, Gypsum, Limestone, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur and **Tripoli** are unchanged from the prices published Dec. 2.

Mineral Products

Arsenious Oxide (white arsenic)—Actual sales averaged about 13.50c. per lb. Small amounts only available; 15c. asked by some dealers.

Copper Sulphate, Potassium Sulphate, and **Sodium Sulphate** are unchanged from quotations of Dec. 2.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $100 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $39, f.o.b. furnace; 16@19 per cent, $38.

Ferrosilicon—10 to 15 per cent, $38 @$40 per gross ton, f.o.b. works; 50 per cent, $75@$80; 75 per cent, $115@$120.

Ferrotungsten—Domestic, 70@80 per cent W, 85@95c. per lb. of contained W, f.o.b. works.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published Dec. 2.

Metal Products

Copper Sheets, Lead Sheets, Nickel Silver, Zinc Sheets and **Yellow Metal** are unchanged from the prices published Dec. 2.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the prices published Dec. 2.

The Iron Trade

Pittsburgh, Dec. 12, 1922

The Carnegie Steel Co. has announced its first-quarter price on sheet bars at $36.50, which will probably be the independent market. The price proves slightly higher than was expected and will certainly help to support the tinplate market at $4.75 and the sheet market at 3.35c.

The Steel Corporation's unfilled obligations decreased 62,045 tons in November. The September increase of 741,502 tons and the October increase of 210,680 tons had been due largely to the heavy bookings in rails and track supplies.

Pig Iron—After the two months' decline in pig iron prices, with a one-sided market, the market now has two sides, as consumers have begun to take hold for first quarter, additional concessions having been made. The market is now $28 on Bessemer, $25 on basic, and $25 to $26 on foundry, Valley, with $1.77 freight to Pittsburgh.

Connellsville Coke—Prices are down farther and production is being slightly restricted. Spot furnace, $6.50@$6.75; spot foundry, $7@$7.50.

The French Ore Market: Iron Ores of Chief Interest

SPECIAL CORRESPONDENCE

Paris, Nov. 27—The only ores that France produces abundantly are those of iron. Since the signing of the Treaty of Versailles, France has become the largest iron-ore producer in Europe. Her September production was 2,064,000 metric tons, or at the rate of about 25,000,000 metric tons per year, and she could produce about twice that tonnage if the mines had a sufficient supply of labor and had the necessary outlet for the ore.

The principal iron-ore formations of France are:

1. The Briey and Thionville formation, the largest part of which is in redeemed Lorraine, yielding an iron ore called minette, which contains about 30 to 35 per cent of iron.

2. The Longwy and Nancy formations, also in the east of France but entirely within the former French territory. These produce siliceous iron ore.

Together, the formations named above produced in September, 1,991,000 metric tons; but the Briey and Thionville formation has a much larger production than the other two.

3. In the west of France, within easy access to the sea, the iron-ore formations of Normandy (September production 52,000 metric tons) and of Brittany and Anjou (production in September, 15,000 metric tons). These ores, which are partly hematites, are of a higher grade than the ores from the east of France.

4. Carbonate and hematite iron-ore formations of the Pyrenean Mountains. (Production in September, 4,448 metric tons only, owing to bad trade, but these mines produced in 1913 a monthly average of 33,000 metric tons).

Besides supplying the ore requirements of her blast furnaces, France is exporting important tonnages of iron ore, as is apparent from the following French customs returns:

FRENCH IRON-ORE EXPORTS, IN METRIC TONS

To	September, 1922	First Nine Months, 1922
Germany	130,811	1,541,842
Belgium (with Luxemburg)	594,479	1,635,865
Sarre	249,838	1,955,072
Netherlands	6,451	172,089
Other countries	237,195	1,504,675
Total	1,218,774	6,809,543

French iron-mine owners are also negotiating with British ironmasters of the Cleveland district about regular shipments of French eastern ore to Great Britain. It may be mentioned, in passing, that if, some day, a stringent shortage of coal in France again induced America to send coal cargoes to this country, French western iron ores might constitute a convenient return freight for the ships so engaged.

The following approximate prices per metric ton, f.o.b. mines, are now quoted for the various French iron ores: Briey, 14@15fr.; Thionville, 11@12fr.; Longwy and Nancy, 10@13fr.; Pyrenean hematite, 32@35fr.; Pyrenean carbonate, 28@30fr.; and Normandy carbonate, 30fr.

Besides iron ore, the only ores that are produced in France in important quantites are bauxite, stibnite, (antimony ore), and barytes.

"Red" bauxite is especially found in the Département du Var, in the south of France, and is used for making aluminum. It sells at from 30 to 45fr. per metric ton, according to grade. "Grayish" bauxite, found in the Départements du Var, de l'Hérault, and des Pyrénées Orientales, is used as refractory material. Bauxite "saumonée" is used, after treatment in an electric furnace, for artifical emery or corundum.

Stibnite is found in many places in France, but is generally of a rather low grade and difficult to treat. To facilitate treatment some high-grade stibnite, imported from Japan, is added to it. The price varies widely.

White baryte, which is chiefly found in the Department de l'Aveyron, is used in the making of colors. The price is 40@70fr. per metric ton.

Calamine and blende are sparsely found in France, and they are low-grade ores. The price quoted is 5@6fr. per metric ton unit of zinc. A few deposits of galena and cerussite are also known.

Iron excepted, France is therefore rather poor in ores. However, Paris is an important foreign-ore market. Manganese ores from the Sinaï and India, failing those from the Caucasus district, which still arrive with difficulty, are being dealt in Paris at 14@15fr. per metric ton unit. Rare-metal ores used for the making of special steels, such as tungsten and molybdenum, are also dealt in on this market. Wolfram ore containing 65 per cent of tungsten is quoted c.i.f. French ports at 14s. 9d. per metric ton unit of tungsten contained.

Exports of Metals and Ores for October, 1921 and 1922

Exports of copper, lead, and zinc during October, 1922, as reported to the Bureau of Foreign and Domestic Commerce, with the revised figures covering exports during October, 1921, are as follows:

	October, 1921	October, 1922
Copper		
Ores, concentrates, matte and regulus (copper content)	.....	22,764
Copper and manufactures of (total)	.....	55,286,035
Refined, in ingots and bars	50,661,282	45,193,264
Exported to:		
Belgium	3,539,245	2,429,231
France	8,463,472	10,359,187
Germany	15,455,089	9,381,056
Italy	2,499,506	7,378,378
Netherlands	3,475,328	2,587,647
Spain	224,056	527,587
Sweden	986,967	4,149,860
United Kingdom	449,047	6,612,120
Canada	4,738	866,508
China	5,680,953	60
Japan	9,676,855	.....
Other countries	206,026	901,630
Old and scrap	.....	331,600
Composition metal, copper chief value	1,524	840
Pipes and tubes	98,019	271,486
Plates and sheets	278,258	493,041
Wire, except insulated	462,603	744,039
Insulated wire and cable	.....	583,985
Lead		
Pigs and bars		
From domestic ore	101,600	954,065
From foreign ore	4,884,650	4,622,774
Exported to:		
France	.....	3,585,391
Germany	1,680,718	.....
Netherlands	.....	336,121
United Kingdom	1,344,596	672,249
Brazil	246,519	701,133
Japan	1,568,000	.....
Other countries	146,417	281,945
Zinc		
Dross	300	553,657
Spelter		
From domestic ore	196,489	1,267,153
Total zinc slabs and blocks	196,489	1,267,153
Exported to:		
France	.....	560,074
Canada	8,306	8,399
Japan	179,222	.....
Other countries	8,961	698,680
In sheets and strips	426,394	398,949
Zinc dust	.....	310,701
Other zinc manufactures	.....	36,459

Owing to complications and accounting difficulties, occasioned by the passage of the new tariff act, the returns from October imports will be much delayed, and will be published later.

Transvaal Gold Production

The following table summarizes Transvaal gold production since 1917, according to the report of the Transvaal Chamber of Mines:

RAND GOLD OUTPUT 1917-1922, IN FINE OUNCES

	1922	1921	1920	1919	1918	1917
January	639,728	651,593	670,503	676,059	714,183	782,631
February		558,137	625,330	636,728	659,759	721,324
March		671,123	707,036	712,379	696,281	787,091
April	511,338	681,382	686,979	694,944	717,099	742,774
May	629,786	687,776	699,041	724,995	741,217	729,388
June	675,697	678,490	715,957	702,379	727,696	759,725
July	730,635	689,555	736,099	725,497	736,199	757,894
August	752,490	711,526	702,083	706,669	740,210	756,650
September	747,089	691,026	682,173	698,558	708,206	732,230
October	778,159	707,000	662,472	723,722	679,764	751,298
November	764,000	704,236	633,737	677,970	658,701	722,839
December	.....	681,847	632,215	650,191	641,245	722,418

COMPANY REPORTS

American Trona Corporation

Potash, borax; California

A report issued on Nov. 22 by the American Trona Corporation states that in the last year's report, toward the end of April, 1921, it was deemed advisable to suspend production operations of the corporation's plant at Searles Lake, pending an improvement in market and general conditions. Operations were resumed April 10, 1922, after the plant had been closed down for practically a year. To the end of September, there were produced 9,063 tons of high-grade potash salts and 3,697 tons of refined borax. Since the resumption of operations at Trona the weekly production of salts has steadily increased, and the cost of production has been steadily reduced at a gratifying rate, as is shown by the following comparative figures:

PRODUCTION AND RELATIVE COSTS OF AMERICAN TRONA CORPORATION

Comparison First Four Months of	Production in Tons of 2,000 Lb.					Fuel-Oil Consumption in Gallons		Cost Based on 1919 Production Costs as 100 Per Cent		
	Potash			Borax						
	Salts	Average Grade in Per Cent	Potassium Chloride Content (100 per cent KCl)		Total Tons Potassium Chloride and Borax	Per Ton Potassium Chloride Produced	Per Aver. Ton Potassium Chloride and Borax Produced	Per Ton Potassium Chloride Produced	Per Ton Borax Produced	Per Aver. Ton Potassium Chloride and Borax Produced
1919	4,791	61	2,941	No borax produced	2,941	1,647	No borax produced	100	No borax produced	100
1920	3,369	89	3,019	1,430	4,499	857	584	58.3	100	59.3
1921	5,599	91	5,102	2,547	7,649	417	279	32.6	54	33.4
(a) 1922	6,593	92.6	6,108	2,834	8,942	371	253	24.4	40	24.9

(a) First four months in operation—May to August, 1922, inclusive.

The duty on potash, originally included in the General Tariff Bill as passed by the House of Representatives, was eliminated by the Senate. The conference committee, however, reinstated it at somewhat lower rates, but due to the efforts of the foreign potash trusts, the farming communities were prevailed upon to use their best endeavor to defeat the schedule affording adequate protection to the American potash industry, in consequence of which the duty on potash was finally eliminated from the General Tariff Bill.

The company has, however, lately been able to secure reductions in freight rates which will mean, on the present rate of its production, an economy of about $170,000 per annum on the transportation of its products. At the same time the price of fuel oil, which alone represents over 30 per cent of the production costs, has been reduced from $2.92 per barrel, the price at the beginning of last year, to $1.38 per barrel at the present time.

The demand in the United States for both potash and borax has improved considerably during the last year. Though the price of borax has remained practically stationary, the price of foreign potash has increased from 64c. net per unit of K_2O, as prevailed last year, to 68c. net per unit of K_2O this season, which increase represents an advance of about $2.25 per ton of our salts. The foreign prices are c.i.f. Atlantic Coast ports, to which must be added freight to interior points of consumption. It will thus be seen that owing to the reduction of freight rates from the California plant to the East, also to the lowering of production costs on the one hand and to the increase in the price of potash on the other, the company is in a more favorable competitive position—its advantage increasing in direct ratio to the distance of the overland haul of foreign potash. This favorable position is particularly felt in the Middle West, which is geographically the corporation's natural sales area.

Trona Railway Co.

During 1921, the Trona Railway Co., of which the American Trona Corporation owns the entire stock and bonds, showed an operating revenue of $64,481 and operating expenses of $88,215. Interest on bonds and miscellaneous deductions from income amounted to $27,491, leaving $51,225 net loss, due chiefly to the fact that the American Trona Corporation's plant was closed down most of the year.

California Trona Co.

This company, the entire outstanding securities of which are owned by the American Trona Corporation, during 1921 marketed 350 tons of crude trona and 6,556 tons of common salt, and during the first eight months of 1922, 377 tons of crude trona and 3,404 tons of common salt.

Chile Copper Co.

A report showing the results of the operations of the Chile Exploration Co. for the third quarter of 1922 states that there was treated 1,266,309 tons of ore, averaging 1.72 per cent copper; in the preceding quarter 924,450 tons, averaging 1.68 per cent copper, was treated. The recovery during this quarter was 89.617 per cent, compared with 89.707 per cent for the quarter ended June 30, 1922. The monthly average copper output was 12,783,690 lb., compared with a monthly average of 10,302,573 lb. for the second quarter. The cost of copper produced during the quarter was 6.352c. per lb., including selling and delivery expense, but excluding depreciation and federal taxes and with no credit for miscellaneous income, compared with 7.077c. per lb. for the previous quarter.

The financial outcome of the Chile Copper Co. and the Chile Exploration Co. combined (earnings being based on copper actually delivered) shows for the quarter ended Sept. 30, compared with the returns for the preceding quarter, as follows:

	Third Quarter 1922	Second Quarter 1922
Pounds copper delivered	39,962,339	38,118,450
Net profit on copper delivered	$2,229,795.29	$1,351,073.26
Miscellaneous income	37,698.38	15,97.17
Interest on call loans and bank balances	108,109.65	84,372.09
Total income	$2,375,603.32	$1,451,402.52
Depreciation	$726,435.08	$723,869.86
Amortized discount on 15-year 6 per cent convertible bonds	35,000.00	35,000.00
Accrued bond interest of Chile Copper Co.	787,500.00	787,500.00
Expenses of Chile Copper Co.	7,175.48	12,355.00
Total charges	$1,556,110.56	$1,558,724.86
Balance undivided profits for quarter, both companies	(a) $819,492.76	(b) $107,322.34

(a) Gain. (b) Loss.

The $819,492.76 profit shown above is after deducting $726,435.08 for depreciation, which is a book entry computed on a time basis regardless of production or sale. Furthermore, though the cost of copper produced during the quarter was 6.352c. per lb., following the usual method of applying current deliveries against oldest copper in inventory, the income from the copper delivered during this quarter is based on an average cost of 7.586c. per lb. The copper so delivered was produced at this average cost during the earlier months of this year. Reductions in the cost of producing copper predicted in the annual report for 1921 are being made with gratifying regularity. During October the cost of producing copper was 5.95c. per lb.

The companies had on Nov. 15, $13,742,900, representing cash on hand and marketable securities.

Tomboy Gold Mines Co., Ltd.

Gold; Colorado

A report of the operations of the Tomboy Gold Mines Co., Ltd., for the year ending June 30, 1922, shows a realized profit of £18,152 0s. 2d., exclusive of depreciation. Profit-and-Loss account follows:

DEBIT

	£	s.	d
Mining, milling and general expenses in America	195,877	13	5
Directors' fees	700	0	0
Agency and consulting engineer's fees, legal expenses, cables, postage, traveling expenses, and general expenses in London	1,791	6	5
Interest	55	15	4
Depreciation of plant and machinery	15,540	9	10
Balance carried to balance sheet	2,611	10	4
	216,576	15	4

CREDIT

	£	s.	d.
Bullion and concentrates recovered	213,312	16	11
Sundry receipts	3,263	18	5
	216,576	15	4

The balance sheet as of June 30, 1922, is given in the report as follows:

DEBIT

	£	s.	d.	£	s.	d.
Capital authorized						
350,000 shares of £1 each	350,000	0	0			
Capital issued						
310,000 shares of £1 each				310,000	0	0
Ore account, per contra				90,494	19	11
Sundry creditors and credit balances				47,486	10	2
Outstanding dividends				67	0	0
				448,048	10	1

CREDIT

	£	s.	d.	£	s.	d.
Mining property, plant and machinery, as per last balance sheet	312,785	0	10			
Additions during year ending June 30, 1922	1,036	16	5			
	313,821	17	3			
Less written off for depreciation	15,540	9	10			
				298,281	7	5
Ore, subject to depletion						
Revised market value of ore deposits as at March 1, 1913	323,175	0	2			
Less depletion to June 30, 1922	232,680	0	3			
				90,494	19	11
Stores on hand and in transit				23,974	2	0
Sundry debtors				1,629	4	9
Bullion and concentrates in transit				4,048	3	0
Cash at bankers in London and America				27,969	14	6
Profit-and-loss account						
Balance of loss brought forward from last account	4,262	8	10			
Less profit for year, as per profit-and-loss account	2,611	10	4			
				1,650	18	6
				448,048	10	1

Production amounted to 211,003 tons milled, from which bullion to the value of $874,582.66 was realized, at a cost of $803,463.49.

The report gives total reserves as 802,751 tons, a meaningless and valueless figure, as no statement of grade is mentioned.

In the month of April a fire occurred which destroyed the boiler plant building, ore bins, and about 250 ft. of snow shed and trestle, all of which has been replaced. On July 8 a more serious fire destroyed the boarding house, club building, blacksmith, machine and carpenter shops, but these are being replaced.

Nevada Consolidated Copper Co. Shows Loss for Third Quarter

A report of the operations of the Nevada Consolidated Copper Co. for the quarter ending Sept. 30, 1922, shows a total copper production of 4,778,300 lb. for the quarter, compared with a total of 11,535,910 lb. for the previous quarter.

A total of 41,936 dry tons of Nevada Consolidated ore, averaging 1.505 per cent copper, was milled, and 34,678 dry tons of Ruth mine direct smelting ore, averaging 6.127 per cent copper, was received at the smelter. In addition to the company ores, there was purchased and smelted 1,667 dry tons of custom ore, which is reported as averaging 5.912 per cent copper.

The cost of production per pound of copper, including all fixed and general expenses, other than federal taxes, and including also the exceptional expenses incident to the enforced suspension of operations caused by the destruction of the concentrator by fire, on July 9, and the consequent burdening of the ordinary, as well as extraordinary, expenses upon a limited production, was 17.48c. per pound. This cost does not include credit for gold and silver values and miscellaneous earnings, which amounted to 0.98c. per pound of copper. Fiscal results for the third and second quarters of 1922 were as indicated in the following tabulation:

COMPARATIVE OPERATING RESULTS

	Third Quarter	Second Quarter
Operating loss	$171,083	$103,309
Shutdown expense and miscellaneous non-operating costs	....	130,910
Miscellaneous earnings and value of gold and silver	46,804	89,803
Decrease in surplus account	$124,278	$144,415

The reconstruction of concentrating plant has progressed rapidly and satisfactorily. The erection of the steel superstructure and the installation of sufficient equipment in one section of the mill, having a capacity of treating an average of 1,000 tons of ore daily, was completed and turned over for continuous operation on Sept. 16. The interval between the burning of the mill on July 9 and the starting of operation on Sept. 16 was 69 days.

The construction of steel ore bins, erection of the main concentrator building and the installation of machinery and equipment was continued with satisfactory progress. The steel building superstructure for two units, or one-half the original mill, is practically erected, and the fine-ore bins of steel construction are completed for one unit. The necessary equipment for crushing, grinding and concentrating an average of 2,000 tons of ore per day has been installed and is under operation. Additional equipment will be in operation by Nov. 30, giving a nominal capacity of about 3,000 tons of ore per day, with an average recovery of 80 per cent of the copper contained in the ore. Starting with December, the treatment of the concentrate product of this tonnage, together with an adequate quantity of high-grade direct-smelting ore from the Ruth mine, will result in restoring the production of copper to the curtailed rate of output prevailing when the fire occurred.

By the middle of January, the steel ore bins for both units will be completed and the reconstructed facilities will have a capacity approximately equal to that at which the concentrator was operating at the time of the fire. By the end of March two complete units, containing eighteen grinding mills, will have been rebuilt and equipped, which will give a capacity to mill of from 7,500 to 9,000 tons of ore per day. This, exclusive of metal recovered from the Ruth high-grade ores, will give a production of from five to seven million pounds per month, depending upon operating conditions and on the various factors of production and market requirements.

Buildings and equipment for the third unit have been ordered for erection and installation when spring weather opens. When these are completed, the mill will have a capacity in excess of the four units of the original plant and will be capable of producing approximately ten million pounds of copper per month.

MINING STOCKS

Week Ended Dec. 9, 1922

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	59	56	57	Aug. '22, Q	$1.00
Alaska-Br. Col.	N. Y. Curb	2⅛	2	2⅛	.....	....
Allouez	Boston	21	20	21	Mar. '19	1.00
Anaconda	New York	49½	47½	48½	Nov. '20, Q	1.00
Arcadian Consol.	Boston	2⅞	2⅛	2⅛	.....	....
Ariz. Com'l	Boston	7⅛	7	7	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*5	*3	*4	.....	....
Bingham Mines	Boston	18⅛	17¼	17⅞	Sept. '19, Q	0.25
Calumet & Arizona	Boston	...	...	54	Sept. '22, Q	0.50
Calumet & Hecla	Boston	292	280	281	Aug. '22, Q	5.00
Canada Copper	N. Y. Curb	*2	*2	*2	.....	....
Centennial	Boston	†9	†8	8	Dec. '18, SA	1.00
Cerro de Pasco	New York	43⅜	41½	43	Mar. '21, Q	0.50
Chile Copper	New York	27⅞	26⅜	26⅝	.....	....
Chino	New York	24⅝	23½	23⅝	Sept. '20, Q	0.37
Copper Range	Boston	38	36⅜	36½	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1 1/16	1	1 1/16	.....	....
Davis-Daly	Boston	3½	2⅜	2⅜	Mar. '20, Q	0.25
East Butte	Boston	8½	7¾	8	Dec. '19, A	0.50
First National	Boston Curb	*50	*45	*46	Feb. '19, SA	0.15
Franklin	Boston	1½	1	1	.....	....
Gadsden Copper	N. Y. Curb	*70	*70	*70	.....	....
Granby Consol.	New York	25	24	25	May '19, Q	1.25
Greene-Cananea	New York	25½	24½	24⅝	Nov. '20, Q	0.50
Hancock	Boston	†2½	†2½	2	.....	....
Howe Sound	N. Y. Curb	2¼	2⅛	2⅛	Jan. '21, Q	0.05
Inspiration Consol.	New York	35⅛	33¼	33½	Oct. '20, Q	1.00
Iron Cap	Boston Curb	4⅛	4⅛	4⅛	Sept. '20, K	0.25
Isle Royale	Boston	21	21	21	Aug. '22,	0.50
Kennecott	New York	35⅝	33⅜	35⅜	Dec. '20, Q	0.50
Keweenaw	Boston	1½	1½	1½	.....	....
Lake Copper	Boston	3½	3½	3½	.....	....
Magma Copper	N. Y. Curb	...	...	34	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	1⅜	1⅛	1⅜	.....	....
Mass Consolidated	Boston	2½	2	2	Nov. '17, Q	1.00
Miami Copper	New York	27⅜	26⅜	27⅛	Nov. '22, Q	0.50
Michigan	Boston	1⅞	1⅛	1⅛	.....	....
Mohawk	Boston	58	56½	56½	Nov. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	...	...	11	June '22, I	0.50
Nevada Consol.	New York	14⅞	14	14	Sept. '20, Q	0.25
New Cornelia	Boston	16	15½	15⅝	Nov. '22, Q	0.25
North Butte	Boston	10	9	9	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*50	*44	*49	.....	....
Old Dominion	Boston	17	16½	16½	Dec. '18, Q	1.00
Osceola	Boston	29½	29	29	Aug. '22, Q	1.00
Phelps Dodge	Open Mar.	†165	†155	....	Oct. '22, Q	1.00
Quincy	Boston	33	32	32	Mar. '20, Q	1.00
Ray Consolidated	New York	14	13½	13⅜	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1⅜	1 1/16	1⅛	.....	....
St. Mary's Min. Ld.	Boston	39	39	39	Apr. '22, K	2.00
Seneca Copper	Boston	...	...	8	.....	....
Shannon	Boston	*57	*55	*55	Nov. '17, Q	0.25
Shattuck Arizona	New York	7	7	7	Jan. '20, Q	0.25
South Lake	Boston	*30	*30	*30	.....	....
Superior & Boston	Boston	1⅛	1⅛	1⅛	.....	....
Tenn. C. & C. cfs.	New York	9⅛	9	9⅛	May '18, I	1.00
Tuolumne	Boston	*60	*48	*50	May '13,	0.10
United Verde Ex	Boston Curb	27	25½	26½	Nov. '22, Q	0.25
Utah Consol.	Boston	2	1½	1⅝	Sept '18,	0.25
Utah Copper	New York	63⅜	61	62	Sept. '22, Q	0.50
Utah Metal & T.	Boston	1	*85	*95	Dec. '17,	0.30
Victoria	Boston	†1	†¼	⅜	.....	....
Winona	Boston	1	1	1	.....	....
Wolverine	Boston	8	7½	7½	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	15	14	14½	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	70	69	70	Nov. '22, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	4⅜	4	4	.....	....
National Lead	New York	124½	114	124½	Sept. '22, Q	1.50
National Lead, pfd.	New York	114	112	113⅝	Nov. '22, Q	1.75
St. Joseph Lead	New York	19½	19	19½	Sept. '22, Q	0.25
ZINC						
Am. Z. L. & S.	New York	15⅛	15	15	May '20,	1.00
Am. Z. L. & S. pfd.	New York	49	49	49	Nov. '20, Q	1.50
Butte C. & Z.	New York	9⅛	7⅞	9	June '18,	0.50
Butte & Superior	New York	31	28	30⅛	Sept. '20,	1.25
Callahan Zn-Ld	New York	8⅛	7	7⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	174½	169	169½	Nov. '22, Q	2.00
Yellow Pine	Los Angeles	....	....	*75	Sept. '20, Q	0.03
SILVER						
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*30½	*29	*29	May '20, K	0.03
Coniagas	Toronto	1.90	1.85	1.90	May '21, Q	0.12½
Crown Reserve	Toronto	*30	*29	*29½	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3⅛	3⅛	3⅛	Oct. '22, Q	0.12½
La Rose	Toronto	*26½	*22	*26	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*23½	*18	*20	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	*97	*97	*97	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	5⅞	5⅛	5⅛	Oct. '22, Q,X	0.30
Ontario Silver	New York	5⅜	5⅛	5⅛	Jan. '19, Q	0.50
Temiskaming	Toronto	*34	*32½	*34	Jan. '20, K	0.04
Trethewey	Toronto	5	5	5	Jan. '19,	0.05
Alaska Gold	New York	⅜	¼	¼	.....	....

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Juneau	New York	1¼	1	1⅛	.....	....
Atlas	Toronto	*12½	*11½	*11½	.....	....
Carson Hill	Boston	7⅛	6½	7⅛	.....	....
Cresson Consol. G.	N. Y. Curb	2 3/16	2⅛	2 3/16	Oct. '22 Q.	0.10
Dome Mines	New York	44½	41	43	Oct. '22, Q	0.50
Golden Cycle	Colo. Springs	*86	*86	*86	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	...	...	*6	Dec. '19,	0.05
Hollinger Consol.	Toronto	12.60	11.60	12.60	Dec. '22,	0.05
Homestake Mining	New York	80½	80½	80½	Nov. '22, M	0.50
Keora	Toronto	*9	*8⅜	*8⅜	.....	....
Kirkland Lake	Toronto	*43	*38	*43	.....	....
Lake Shore	Toronto	2.90	2.87	2.90	Nov. '22, Q	0.02
McIntyre- Porcupine.	Toronto	19.05	18.00	19.05	Sept. '22, K	0.25
Porcupine Crown	Toronto	*19	*17	*18	July '17,	0.03
Portland	Colo. Springs	*39	*38	*39	Oct. '20, Q	0.01
Schumacher	Toronto	*45	*42	*45	.....	....
Teck Hughes	Toronto	*85	*82	*82	.....	....
Tom Reed	Los Angeles	*81	*75	*79	Dec. '19,	0.02
United Eastern	N. Y. Curb	1⅜	1⅛	1 3/16	Oct. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*3	*2	*3	Jan. '20, Q	0.01
Vipond Cons.	Toronto	*64	*58	*62	.....	....
White Caps Mining	N. Y. Curb	*10	*10	*10	.....	....
Wright-Hargreaves.	Toronto	3.20	3.05	3.05	Oct. '22,	0.05
Yukon Gold	N. Y. Curb	*80	*65	*80	June '18,	0.02½
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	...	...	*5	.....	....
Cons. Virginia	San Francisco	*11½	*9½	*9½	.....	....
Dolores Esperanza	N. Y. Curb	2¼	2	2⅛	Oct. '22	2.50
El Salvador	N. Y. Curb	*3	*2	*3	.....	....
MacNamara M.&M.	N. Y. Curb	*8	*7	*7	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1⅛	1⅛	1⅛	July '22, Q	0.05
Tonopah Divide	N. Y. Curb	*75	*71	*71	.....	....
Tonopah Extension	N. Y. Curb	4⅛	3 5/16	3⅜	Oct. '22, Q	0.05
Tonopah Mining	N. Y. Curb	2 1/16	1 1/16	2 1/16	Oct. '22, SA, X	0.07½
West End Consol.	N. Y. Curb	...	...	1 1/16	Dec. '22, Q.	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*8	*8	*8	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*37	*37	*37	Dec. '20,	0.15
Chief Consol.	Boston Curb	5¼	5	5	Nov. '22, Q	0.10
Columbus Rexall	Salt Lake	*16	*16	*16	Aug. '22,	0.03
Consol. M. & S.	Montreal	27	26½	26⅞	Oct. '20, Q	0.62½
Eagle & Blue Bell	Boston Curb	†*3	†*2	*3	Nov. '22, K	0.05
Federal M. & S.	New York	9	9	9	Jan. '09,	1.50
Federal M. & S. pfd.	New York	52½	52	52	Sept. '22, Q	1.25
Florence Silver	Spokane	*36	*34	*36	Apr. '19,	0.01½
Grand Central	Salt Lake	†*60	...	...	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	8⅜	8⅛	8⅜	Sept. '22, Q	0.15
Iron Blossom Con.	N. Y. Curb	*27	*27	*27	Apr. '22, Q	0.02½
Marsh Mines	N. Y. Curb	*9	*7	*7	June '21, I	0.02
Park City	Salt Lake	3½	3½	3½	.....	....
Prince Consol.	Salt Lake	*8½	*8½	*8½	Nov. '17,	0.02½
Silversmith	Spokane	*48	*46½	*47	Oct. '22,	0.01
Simon Silver Lead	N. Y. Curb	*34	*30	*31	.....	....
Stewart Mines	N. Y. Curb	*6	*6	*6	Dec. '15,	0.05
Tamarack-Custer	Spokane	3.40	3.00	3.25	Jan. '21, K	0.04
Tintic Standard	Salt Lake	3.20	3.05	3.05	Sept. '22, K	0.05
Utah Apex	Boston	3⅛	2⅛	3⅛	Nov. '20, K	0.25
IRON						
Bethlehem Steel "B"	New York	63⅜	60⅜	62½	Oct. '22	1.25
Char. Iron	Detroit	...	...	⅞	.....	....
Char. Iron, pfd	Detroit	...	...	2	.....	....
Colorado Fuel & Iron	New York	26¾	24⅞	24⅞	May '21	0.75
Col. Fuel & Iron, pfd.	New York	...	...	105	Nov. '22	2.00
Gt. North'n Iron Ore	New York	31⅜	30	31⅛	Nov. '20	1.50
Inland Steel	N. Y. Curb	41½	41½	41½	Dec. '22	0.25
Mesabi Iron	N. Y. Curb	13	11⅜	12½	.....	....
Replogle Steel	New York	25¾	23	24⅜	.....	....
Republic I. & S.	New York	47½	44½	47⅛	May '21	1.50
Republic I. S., pfd.	New York	84⅞	83½	83⅛	Jan. '22	1.75
Sloss-Sheffield S. & I.	New York	...	...	37⅞	Feb. '21	1.50
U. S. Steel	New York	104	101	103⅜	Sept. '22	1.25
U. S. Steel, pfd.	New York	121	120½	120⅛	Nov. '22	1.75
Virginia I. C. & C.	New York	56	56	56	Jan. '22	1.50
Virginia I.C.&C.,pfd.	New York	82	81	81	July '22	2.50
VANADIUM						
Vanadium Corp.	New York	35⅜	33	34⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	65	64	64	Oct. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	83½	83	83	Oct. '22, Q	1.75
SULPHUR						
Freeport Texas	New York	19½	18¾	19	Nov. '19, Q	1.00
Texas Gulf	New York	61½	58⅜	59⅛	Sept. '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Metal	New York	48⅛	46⅜	47⅛	Dec. '22, Q	0.75
Amer. Metal pfd.	New York	110⅛	110⅛	110⅛	Dec. '22, Q	1.75
Amer. Sm. & Ref.	New York	54⅛	51⅞	54	Mar. '21, Q	1.00
Amer. Sm.& Ref. pfd	New York	99⅝	99⅛	99⅛	Dec. '22 Q	1.75
Am. Sm. Sec. pfd. A.	New York	...	...	101⅞	Oct. '22, Q	1.50
U. S. Sm. R. & M.	New York	39	38⅛	38⅛	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	47⅞	47⅞	47⅞	Oct. '22 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

NEW MACHINERY AND INVENTIONS

A Method of Weighing CO_2

There was a time when a "manometer" was the only instrument used by power plant operators as a guide in their operations, and it is well known that boilers often have been operated with nothing more than a safety valve to indicate the high-level mark of steam pressure and to warn the fireman of possible danger. In those days there were no means of telling whether or not the plant was operated economically. But that time has passed. The power plants of the present day are equipped with numerous instruments and apparatus with the object of guarding against losses of time, labor, and fuel, as well as against danger.

The fireman nowadays has not only his safety valve to rely on, but he has steam gage, flow meter, automatic feed regulator, excess air meter, draft-control apparatus, soot blower, pyrometer and last but not least, the CO_2 recorder. Any modern plant would not be complete without such instruments to guide and guard its operating forces.

It has been recognized for a long time that excess air is a great enemy to economy in the operation of boiler plants, and it is not unusual to find the engineer searching for air leaks on the outside of the settings. Perhaps the one source of excess air, which is most damaging and at the same time the most difficult to detect, is a hole through the bed of fuel; or, in other words, what is known to the fireman as a "hole in the fire." This, of course, may have various causes, such as the fire burning out faster at one point than at another, the fuel being placed evenly on the grate or a varying of the quality of coal.

In the case of hand firing, one of the principal duties of the fireman is to watch for and prevent such "holes in the fire," as they admit excess air, which, passing up the chimney, carries with it a large amount of valuable heat. "Holes in the fire" are especially difficult to detect in some makes of mechanical stokers, particularly where the boilers are placed close together in batteries or where they are provided with a forced-draft arrangement. To detect "holes in the fire" should be one of the principal objects of the CO_2 apparatus, and, to do this, the latter should be of such nature and so placed as to convey its information to the fireman promptly. A steam gage located in the chief engineer's office, for instance, indicating the boiler pressure, would be of very little help to the fireman; so also is a CO_2 recorder when, as is usually the case, the apparatus is placed too far away from the fire aisle.

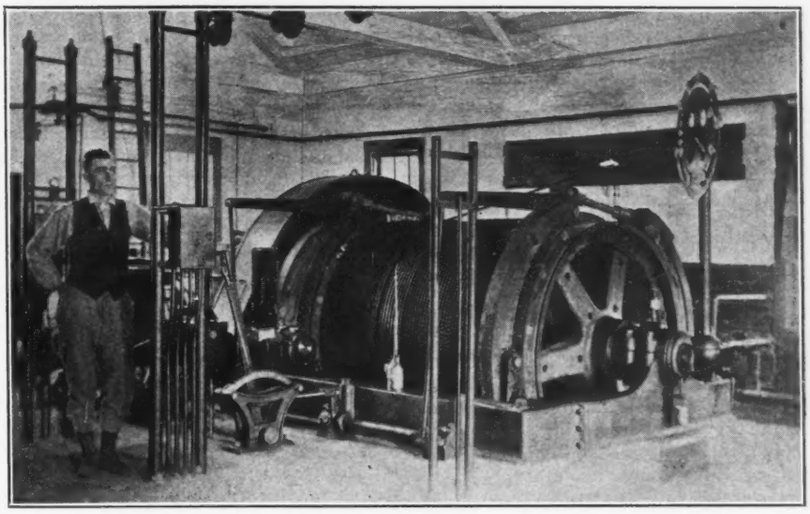
The chief disadvantage, however, of the prevailing type of CO_2 apparatus, is the nature of the apparatus itself, based, as it is, upon the principal of absorption of the CO_2 gas by chemicals, such as caustic potassium, sodium, or lime; in other words, it is in a sense a small laboratory and as such an expensive, delicate, and troublesome affair, which requires keen attention and skillful handling.

Another defect of this type of apparatus is the fact that it delivers its messages so long after the recorded condition has taken place in the furnace that the message is too late and therefore practically worthless.

Recognizing the inadequacy of the present method of measuring CO_2, and appreciating the advantage to the fireman of having a CO_2 indicator placed on the boiler front exactly as the steam gage is placed now, the idea was conceived of constructing a CO_2 measuring apparatus that would continuously weigh the gases as they pass through the apparatus and indicate differences in CO_2 percentage by gravity, rather than by the action of chemical agents, thereby avoiding the difficulties and nuisances that are attached to this latter method.

The adoption of the weighing principle, which is said to eliminate entirely glass bottles, chemicals, and other trouble, is incorporated in a machine, known as the Olsson Gas Balance. This consists of a balance that operates automatically and continuously. The instrument is very sensitive to fluctuations of the percentage of CO_2, and the readings follow only a few seconds after the actual change has taken place. It is manufactured by the Olsson Corporation, 7 Hanover St., New York City.

National Tank & Pipe Co., Portland, Ore., recently furnished two carloads of large tanks for the American Zinc & Lead Co. at Neihart, Mont. The tanks were sold to the Stearns Roger Mfg. Co., Denver, Colo., which had the contract for the installation of the plant.



A 200-hp. electric hoist with drum 6 x 6 ft. installed at the Fogarty mine of Pickands-Mather Co. at Caspian, Mich. This hoist has a single reduction of herring-bone gears 15 to 1, has double post brakes, and is equipped with hoist control.

Federal Specifications for Leather Belting

The new federal specifications for leather belting provide for tests which may be applied in any physical laboratory. First, the average tensile strength of five samples of single belting must be 3,750 lb. per sq.in. or more, and the minimum strength of any one of these five samples must be not less than 3,000 lb. per sq.in. of cross section. Second, stretch. The average elongation of the five samples at a tensile stress of 2,500 lb. per sq.in. shall not exceed 15 per cent. The belt itself shall be suspended in a vertical position and sufficient weight, including the weight of the clamp, shall be attached to the lower clamp to produce a tensile stress of 750 lb. per sq.in. of the average cross section. After fifteen minutes' suspension, this section of 10 ft. shall show a length between gage marks not to exceed 10 ft. 7.2 in. (6 per cent stretch). Third, elasticity. The clamps shall then be removed and the sections allowed to lie loosely on the floor for seventeen hours, after which time the length between the gage marks shall not exceed 10 ft. 1.6 in. (1½ per cent stretch). Fourth, piping: The leather shall not show wrinkles on the grain side (commonly called piping) when bent through an angle of 180 deg., grain side in, over forms specified for different grades and thicknesses.

The application of these four tests will expose any inferior stock which may be tested. An unusually high tensile strength, coupled with an excessive stretch and low elasticity, would indicate lower edge stock, which the piping test would confirm, whereas a moderate tensile strength slightly above the specifications provision, with stretch within the limitations and elasticity as provided, will indicate superior material.

These specifications accomplished what has been desired in differentiating

between first- and second-quality material in leather belting, and a copy of them should be in the hands of every concern whose belting purchases are of sufficient importance to make the subject interesting. This may be obtained by addressing The Leather Belting Exchange, Philadelphia.

Double Gap Section Insulator for Use in Mines

Electrification of mines has made necessary extensive overhead construction in each mine, and since the mining industry employs a majority of unskilled laborers, it is necessary to have a means of protecting these laborers while they are performing their duties. This protection is usually afforded by the use of section insulators, which in most states are required by law.

The Westinghouse Electric & Manufacturing Co. has developed a double gap section insulator which meets all service conditions and also fulfills the requirements of the mining laws. It is a double-beam insulator having two air gaps as insulating mediums and a hand-operated switch mounted on top of the wooden beams, and is for use in mines having an operating voltage of 600 volts or less. The arcing tips, castings, and approaches are made of bronze, and are all renewable. The switch contacts, mounted on top of the end casting, are also renewable.

The insulator was designed to give the operator a device that would be convenient in service as well as durable. This was accomplished by making all wearing parts, such as the switch contacts, arcing tips, and approaches, renewable. In service, all these parts can be renewed without removing the insulator from the line. The two beams, one on each side of the arcing tips, leave a clear space above, and no trouble is caused from the arc charring the beam. This arrangement also has the advantage of giving a blow-out effect on the arc when opening the switch under load.

INDUSTRIAL NOTES

T. E. Doremus, who for the last three and a half years has represented E. I. du Pont de Nemours & Co. as general eastern manager for the Orient, with headquarters at Shanghai, China, has returned to the United States. Mr. Doremus is now situated at Seattle, Wash., where he is manager for the explosive department of the du Pont company.

E. T. Fishwick, formerly sales manager of the Worthington Pump & Machinery Corporation, has been made vice-president in charge of sales to succeed F. H. Jones, who has resigned. J. E. Sague, vice-president, has been succeeded by William Goodman, formerly assistant to the vice-president. James C. Barnaby, formerly plant engineer of the Staten Island Shipbuilding Co. is now in charge of certain engineering work in the Diesel oil engine division of the Worthington company.

Christian Louis Berger, founder of C. L. Berger & Sons, Roxbury, Mass., died during November at the age of eighty. Mr. Berger was an outstanding figure in the engineering instrument profession. Born in Stuttgart, Germany, he was early apprenticed to Christian Saeger, a famous manufacturer of instruments, and underwent special training for four years. He later attended the Royal Polytechnic Institute. In 1866 he came to America and in 1871, after fifteen years' association with instrument makers, he established his own business in Boston, Mass. In 1898 Mr. Berger took his two sons, W. L. and L. H. Berger, into the firm, and in 1902 the factory was established at Roxbury. Mr. Berger was the author of many technical articles dealing with the subject of engineering instruments.

TRADE CATALOGS

Steel Tubes, Rods and Shafting—Peter A. Frasse & Co., 417 Canal St., New York, have recently issued a 64-p. stock list containing specifications and prices of tool steels, drill rods, alloy steels, shafting, and steel tubes.

Surveying Instruments—C. L. Berger & Sons, 37 William St., Boston, Mass., have recently issued the thirty-seventh edition of their handbook and catalog of engineering, surveying, and mining instruments. Part I contains a full description of the instruments and directions concerning their use, care, and adjustment. Part II consists of a catalog and price list.

Portable Tools—The Black & Decker Mfg. Co., Baltimore, Md., has recently issued a 32-p., well-illustrated catalog (No. 5) descriptive of the company's portable electric tools and shop equipment. A chapter on the manner of grinding drill bits is included. With the exception of electric drills for coal, the equipment listed is applicable principally to shop and construction work.

Electrical Equipment—We are in receipt of a book issued by the Holtzer-Cabot Electric Co., Boston, Mass., which is comprised of twelve bulletins covering respectively: intercommunicating telephone systems; annunciators and signaling apparatus; bells, buzzers, horns, push buttons, and relays; magneto clocks; testing magnetos; hospital signal systems; nurses' calling systems for existing hospitals; fire-alarm apparatus; audible calling apparatus; loud-ringing polarized bells; telephone arms, and tubular wire connectors. These bulletins contain much information that will be of interest to mining companies, and the devices described will find a ready use in underground and surface operations.

CONSTRUCTION NEWS

New Town Is Being Built by Oliver Iron Mining Co.

The Oliver Iron Mining Co. has started the construction of twenty-five new dwellings near its Fraser open pit on the Mesabi Range in Minnesota to serve the employees of the mines there. Construction will consist of fifteen five-room houses, three six-room houses, six seven-room houses and one eight-room house. In addition to the above new houses, nine additional houses have been purchased from other companies, and these will be moved to the new location. A water and sewer system is now being installed.

Leadville Mines Co. Increases Capacity of Flotation Plant

The Leadville Mines Co., operating a lead-silver mine at Gerlock, Nev., has added a 75 hp. Fairbanks Morse semi-Diesel oil engine to the central power plant, and a 40-hp. electric hoist at the inside shaft. Changes are being made in the flotation mill which will increase the daily capacity from 40 to 60 tons. The present intention is to operate the mine and mill during the winter months. Four carloads of concentrates were shipped in November.

New Highways and Railroad for Portland Canal District, B. C.

About $95,000 is expected to be spent by the Provincial Government of British Columbia next year in road construction in the Portland Canal mining district of British Columbia. There is some work from the townsite of Stewart to the wharf that will involve an expenditure of $30,000, and it is stated that two spans are to be thrown over the Bear River at the site of the present bridge, costing between $25,000 and $30,000. The Bear River wagon road is to be improved, it being understood that the construction is to extend as far as American Creek.

G. A. Carlson, of the firm of Seims & Carlson, Spokane, Wash., is quoted as stating that he has a contract for the building of 13 miles of railway up the Salmon River valley. The line is said to be planned to start from tidewater at a point near Hyder, Alaska, proceeding up the east side of the valley.

Amazon-Dixie Development Said to Warrant Mill

The Amazon-Dixie Mining Co. is soon to have a mill, at its mine in the east end of the Coeur d'Alene district, of Idaho. Sildix is the railroad station. This depends on whether the large body of milling ore being developed proves as extensive as its appearance now indicates. This showing is on the 1,500 level, where about 15 ft. of good milling lead-silver ore is opened. Wesley Everett is manager.